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## CULTURE AND SCIENCE.

BY THEODORE GILL.

A SHORT time ago, it will be remembered, an English gentleman, eminent as a classical scholar, and as a man of refined and æsthetic tastes, otherwise culture, delivered a lament in this city on the decadence of literature and the usurpation of science. He whom we are wont to call, without titular prenomen, Matthew Arnold, has long enjoyed the esteem of all English-speaking peoples, and I think that I can safely say that scientific men generally commiserate with the eminent *littérateur* in his evident grief, although they must equally generally fail either to discover the ground for his prognostications or to dread the impending dilemma. The Cassandraic laments of the apostle of culture have long been re-echoing throughout Great and Greater Britain, and his latest utterances were essentially the repetition of the wailings poured out into the sympathetic ears of the select Cantabrigian scholars and published broadcast in the *Nineteenth Century* some eighteen months ago (Aug. 1883, pp. 216–230). What his feelings were then and long before are thus told by him.

"'*No wisdom, nor counsel, nor understanding, against the Eternal!* says the Wise Man.' Against the natural and appointed course of things there is no contending. Ten years ago I remarked on the gloomy prospect for letters in this country, inasmuch as while the aristocratic class, according to a famous dictum of Lord Beaconsfield, was totally indifferent to letters, the friends of physical science to the other hand, a growing and popular body, were in active revol against them. To deprive letters of the too great place they had hitherto filled in men's estimation, and to substitute other studies

for them, was now the object, I observed, of a sort of crusade with the friends of physical science—a busy host important in itself, important because of the gifted leaders who march at its head, important from its strong and increasing hold upon public favor.

"I could not help, I then went on to say, I could not help being moved with a desire to plead with the friends of physical science on behalf of letters, and in deprecation of the slight which they put upon them. But from giving effect to this desire I was at that time drawn off by more pressing matters. Ten years have passed, and the prospects of any pleader for letters have certainly not mended. If the friends of physical science were in the morning sunshine of popular favor even then, they stand now in its meridian radiance. Sir Josiah Mason founds a college at Birmingham to exclude "mere literary instruction and education;" and at its opening a brilliant and charming debater, Professor Huxley, is brought down to pronounce their funeral oration. Mr. Bright, in his zeal for the United States, exhorts young people to drink deep of 'Hiawatha;' and the *Times*, which takes the gloomiest view possible of the future of letters, and thinks that a hundred years hence there will only be a few eccentrics reading letters and almost every one will be studying the natural sciences—the *Times*, instead of counselling Mr. Bright's young people rather to drink deep of *Homer*, is for giving them, above all, 'the works of Darwin and Lyell and Bell and Huxley,' and for nourishing them upon the voyage of the 'Challenger.' Stranger still, a brilliant man of letters in France, M. Renan, assigns the same date of a hundred years hence, as the date by which the historical and critical studies, in which his life has been passed and his reputation made, will have fallen into neglect, and deservedly so fallen. It is the regret of his life, M. Renan tells us, that he did not himself originally pursue the natural sciences, in which he might have forestalled Darwin in his discoveries."

Are Mr. Arnold's representations respecting the attitude towards literature on the part of the advocates of physical science literally correct? Are they not exaggerated? Most certainly the curriculum of Sir Josiah Mason's Science School does not exclude literary instruction, but only such as the sole objective end, and Professor Huxley happily anticipated the objection made on the occasion referred to by Mr. Arnold. As I have elsewhere[1] shown, in a review of Professor Huxley's Science and Culture, he fully recognizes the urgency of literary culture, and simply deprecates an

[1] The Critic (New York).

undue attention to the neglect of more practical studies. On the occasion in question he merely reiterates them; and to those who would urge that want of cultivation of the ancient languages and literature entails narrowness of thought, he replies that "the advocates of scientific education might fairly enough retort upon the modern Humanists that they may be learned specialists, but that they possess no such sound foundation for a criticism of life as deserves the name of culture. And, indeed, if we were disposed to be cruel, we might urge that the Humanists have brought this reproach upon themselves, not because they are too full of the spirit of the ancient Greek, but because they lack it." Nevertheless, he afterwards says, he is "the last person to question the importance of genuine literary education, or to suppose that intellectual culture can be complete without it. An exclusively scientific training will bring about a mental twist as surely as an exclusively literary training." He thinks that there is no need, however, that such a catastrophe should happen. Instruction in English, French and German, such as is provided for in the Mason Scientific School, renders accessible "the three greatest literatures of the modern world," and if an Englishman cannot get his literary culture out of his Bible, his Shakespeare, his Milton, neither will the profoundest study of Homer and Sophocles, Virgil and Horace, give it to him." These opinions are valuable as emanating from one who in his own person combines scientific and literary culture of no common order.

But what is culture? From the writings of Mr. Arnold, as well as from the observations of those who are generally conceded to be "men of culture," I infer that it has, in the opinions of such, a narrower range than is admitted in the dictionaries of the English language. Therein we learn that culture is "the application of labor or other means to improve good qualities or growth;" or, "specifically, any training or discipline by which man's moral and intellectual nature is elevated; or, "the result of such training, enlightenment, civilization, refinement." Further, we learn that "the word culture has made its way among us from Germany mainly through the influence of Goethe, and that "we speak now of the culture, whether of a nation or individual, as a kind of collective noun for all that refers to the higher life."

But it appears that such definitions are too latitudinarian and vague. According to the special culture-worshippers, it seems that certain things must be done and certain other things left undone to entitle to entry into the fold of culture. For example, above all

things the Latin and Greek languages and literatures must be mastered, for the main object in life must be to make and understand classical allusions, and there can be no more grievous sin against culture or more glaring evidence of want thereof than not to understand every inuendo or allusion made in polite converse which springs from a classical source; not only ancient but modern poetry must be read, and not only read but enjoyed (this too is essential), and the principles of metric composition understood; otherwise will the failing individual incur the charge of lack of culture. With a touch of pity Mr. Arnold recalls that "Mr. Darwin once owned to a friend that for his part he did not experience the necessity for two things which most men find so necessary to them—poetry and religion; science and the domestic affections, he thought, were enough."

On the other hand, a very limited knowledge or even ignorance of things practical or natural is tolerable from one who has the positive qualifications specified. Even mathematics has entered too largely into the curriculum of the universities of England, and Mr. Arnold, for instance, declared on the occasion of his address here noticed, that "if in the Cambridge Senate House one may say such a thing without profaneness, I will hazard the opinion that for the majority of mankind a little of mathematics, also, goes a long way. Of course this is quite consistent with their being of immense importance as an instrument to something else; but it is the few who have the aptitude for thus using them, not the bulk of mankind."

Many there are and many must there be who will object to the restriction of the term culture as thus advocated. In fact, the issue, so far as Mr. Arnold is concerned, is not between culture and science, but between a one-sided attention to classical studies and certain departments of science. The alternatives, as they appear to Mr. Arnold, are expressed in the following terms:—

"A certain president of the Section for Mechanical Science in the British Association is, in Scripture phrase, 'very bold,' and declares that if a man, in his education, 'has substituted literature and history for natural science, he has chosen the less useful alternative.' Whether we go to these lengths or not, we must all admit that in natural science the habit gained of dealing with facts is a most valuable discipline, and that every one should have some experience of it.

"But it is proposed to make the training in natural science the main part of education, for the great majority of mankind at any

rate. And here, I confess, I part company with the friends of physical science, with whom up to this point I have been agreeing. In differing from them, however, I wish to proceed with the utmost caution and diffidence. The smallness of my acquaintance with the disciplines of natural science is ever before my mind, and I am fearful of doing them injustice. The ability of the partisans of natural science makes them formidable persons to contradict. The tone of tentative inquiry, which befits a being of dim faculties and bounded knowledge, is the tone I would wish to take and not to depart from. At present it seems to me, that those who are for giving to natural knowledge, as they call it, the chief place in the education of the majority of mankind, leave one important thing out of their account —the constitution of human nature."

That important element to the constitution of human nature, we elsewhere learn. A knowledge of all nature (and man is a part) is the domain of Science, but still, we are told, "it will be knowledge only which they give us; knowledge not put up for us into relation with our sense for conduct, our sense for beauty, and touched with emotion by being so put; not thus put for us, and therefore, to the majority of mankind, after a certain while unsatisfying, wearying."

I cannot forbear, in this connection, to once more cite Mr. Arnold. In his Cambridge address he recalled to his auditors a certain utterance of his of the past.

"Some of you," he said, "may have met with a phrase of mine which has been the object of a good deal of comment; an observation to the effect that in our culture, the aim being to know ourselves and the world, we have, as the means to this end, to know the best which has been thought and said in the world."

But to know only the best, however desirable—and it is supereminently so—is only to very imperfectly know the world and human nature. And the experience of many in this audience will attest to the fact that idiosyncracies are only partially controlled by education. Many classical students,—many who have passed with honor out of our colleges after having pursued the entire curriculum of the humanities—have shown a lack of morality and integrity all the more glaring because of their culture, and I doubt not that some of you may recall those whose scholastic training has been ripe but yet who have ended their career in a prison cell. Some of those who have thus lapsed have done so in consequence of the inaptness of their furniture for the struggle of life. There are those of

them too, I know, who have charged their incomplete lives to that insufficiency of a collegiate course for the practical end of existence. This insufficiency has become so patent to many that they have demanded a change in the college curriculum, and this demand has come less from those interested in scientific pursuits than from those who have contemplated from outside the triumphs of science and have desired its advantages to be more feely extended and opened. The advantages of a scientific training are so evident that they need not be urged. In the words of Mr. Arnold, "the great results of the scientific investigation of nature we are agreed upon knowing, but how much of our study are we bound to give to the processes by which those results are reached? The results have their visible bearing on human life. But all the processes, too, all the items of fact, by which those results are established, are interesting. All knowledge is interesting to a wise man, and the knowledge of nature is interesting to all men."

It is in view of this conceded usefulness of science and its relations to everyday life that there is an ever-increasing demand on the part of comparatively disinterested lookers-on to force it into college. This demand, as before indicated, is not so much from the acknowledged representatives of science as from the general community, and men of science interpose ever to moderate the demand and to recommend the retention of what are called the humanities in the educational course. They urge that it is not the part of science or true culture (which amount to almost the same thing) to reject the one and to devote attention alone to the contemplation of gross matter. They are satisfied to give room and time, so far as may be possible, to all knowledge, and they do not find fault even with those who, like Mr. Arnold, think that "if there is to be separation and option between humane letters on the one hand and the natural sciences on the other, the great majority of mankind, all who have not exceptional and overpowering aptitudes for the study of nature, would do well to choose to be educated in humane letters rather than in the natural sciences. Letters will call out their being at more points, will make them live more.

"And, indeed," continues Mr. Arnold, "to say the truth, I cannot really think that humane letters are in danger of being thrust out from their leading-place in education, in spite of the array of authorities against them at this moment. So long as human nature is what it is, their attractions will remain irresistible. They will be studied more

rationally, but they will not lose their place. What will happen will rather be crowded into education other matters besides, far too many; there will be, perhaps, a period of unsettlement and confusion and false tendency; but letters will not in the end lose their leading place. If they lose it for a time, they will get it back again. We shall be brought back to them by our wants and aspirations. And a poor humanist may possess his soul in patience, neither strive nor cry, admit the energy and brilliancy of the partisans of physical science, and their present favour with the public to be far greater than his own, and still have a happy faith that the nature of things works silently on behalf of the studies which he loves, and that, while we shall all have to acquaint ourselves with the great results reached by modern science, and to give ourselves as much training in its disciplines as we can conveniently carry, yet the majority of men will always require humane letters, and so much the more as they have the more and the greater results of science to relate to the need in man for conduct, and to the need in him for beauty."

There is much in these utterances of Mr. Arnold which can be re-echoed by the man of science. Doubtless the exclusive status of the humanities in the educational curriculum has been lost beyond redemption; in some institutions, at least, they no longer take the lead, and above all, their study has been to some extent sanctified by scientific methods. But the enlightened chiefs of science, far from denying, claim a place for the humanities parallel with those of their own chosen departments. What they do propose, in response to popular clamor, is not to exclude classical studies, but to leave to those students who have matured sufficiently to face a near future the option of a course which may be most useful to them in their after careers. The knowable is only less measurable than the unknowable, but human capacity and life are finite. Grecolatry and Latinolatry are sometimes obstructive. The physician will have less use for a profound knowledge of the humanities than of humanity; the chemist or miner will doubtless find Greek and Latin of use, but much less than German or French and still less than an elementary acquaintance with matter. The future merchant may be glad to bandy classical allusions with his customers, but a knowledge acquired, in the schools, of the objects of his trade will save much cost and labor in those years when time and labor are of most account. Let all be allowed to elect those

studies which may be most useful to them in their chosen walks in life.

In coming time there must needs be a modification of educational methods for adaptation to the increasing ramification and development of the tree of knowledge; and if early youth is the best time for learning languages, so is it—and to even a greater degree—the best time for the cultivation of the logical and observing faculties. There must be sacrifice of some branch of learning, and what that shall be should probably be determined by the position of the individual and his tastes and aptitude. A technical education is at least more likely to be of future use to most persons than a classical one, and will certainly fit one better for the struggle of life, even if, as might be contended, it will be less apt to render him "philosophical" under its calamities.

I cannot forbear, even at the risk of being regarded digressive, to here interject some remarks respecting the place of the classical languages in general philosophy. We are constantly being told that the Latin and Greek are the most perfected and the highest developed of all tongues, and it is implied that others are less so to the extent by which they deviate from those stocks. I have no hesitation in utterly denying such a statement, and the claim in question is the result of that lack of broad culture which is incident to exclusive or undue attention to what is called a classical curriculum. The Greek and Latin languages really represent an immature although nearly adolescent stage of linguistic development, the former being nearer the primitive stage, while the latter is on the whole appreciably more advanced in natural development. The inflections, which have been claimed as a feature of excellence, in truth are characteristic of the youth of language and of barbarous peoples. Such nations, for example, as the American aborigines (Choctaws, Creeks, etc.) and the Eskimo, exhibit a complexity of inflection which is immeasurably in advance of the classical ones, and the same reasons which have been urged for the supremacy of Greek and Latin are applicable in a far higher degree to the Eskimo and Choctaw. The decay of inflections may almost be said to be in an inverse ratio to the healthy growth of expression, and we may justly claim, on scientific grounds, that of all languages, English is the most advanced in its developmental career, so far at least as differentiation of its elements is concerned. These utterances, although they may appear heterodox to some, I feel

assured will be challenged by no scientific philologist. It would be easy to justify them, but time forbids. I close, therefore, with some ideas as to the relations of Science and Culture.

Science is often personified as an aggressive being and even as a demon, shoving and pushing all else away and endeavoring to throttle and kill all else, that it alone may live and flourish. A falser conception is scarcely possible. This aggressive demon is not science, but a man of straw. Yet the disciples of theology and the apostles of culture seem to be made alike unhappy in their contemplation of the portentous and horrid offspring of their imaginings, and batter away at the impassive man of straw while complaining of his aggressions. Science is rather a goddess who is rich in attributes and ready to reward her worshippers, but coy in her gifts; she is generous only to those who worship at her shrine in sincerity and truth, and who supplement their prayers by continual labor and deeds. To such she distributes her gifts much according to their deserts. Her worshippers are generally content with their several portions, and in her temple enjoy such sweet communion and peace of mind that they envy not the lots of those outside; if at all solicitous for any outsiders they are actuated by motives of philanthropy and benevolence alone to invite such to share with them. What other possible motive can there be for proselytism? They repose in the temple, itself on an eminence above the turbid billows of popular boisterousness, and can contemplate without alarm the strife of faction and of sects below. The outcries and assaults against science are, therefore, without justification, and are evidently the outcome of jealousy and rivalry among the worshippers at other shrines; those interests appear to be imperilled, and they dread popularity so manifested by the number of votaries wending their way in ever-increasing throngs to her temple. Such pilgrims, however, are not unthinking followers of aggressive and proselytizing apostles, but are attracted by the clear atmosphere of the heights on which the temple is perched and by the gifts which the goddess half conceals and only imperfectly exhibits to new disciples.

Near her portals, there are no runners who clamor to all in view to come in and believe as they do or be killed and damned. The priests who guard her shrine warn those that would approach to come *not* save they are prepared to cast off their garments of prejudice and to test all things by trained sense, experience, and reason.

Her votaries are not forbidden to doubt what is uttered in her temple; doubt as encouraged as a prelude to faith.

Science is most catholic in her regards, and none are denied entrance to her temple who submit to her laws. Conditions are imposed, it is true; but all those who give obedience to the few conditions are admissible. One of the conditions is that common sense intensified shall be applied to all questions. If it is the historian, he must learn to doubt and to weigh the statements handed down from posterity; if the Greek or Latin scholar, he is refused, not because of his Greek and Latin as taught in the schools, but because only so knowing he knows too little and too imperfectly; when he has gained increased knowledge and breadth of view so that he knows his language as a harmonious part of a great whole, he, too, is eligible. Science takes cognizance of all nature and all the outcome of nature. How, then, can there be any antagonism between science and culture when true culture is only an esteemed and devoted offspring of science? Any antagonism between the two is as causeless and insensate as the revolt of the members against the body imagined in the ancient apologue.

# ON THE GROSS ANATOMY OF CAMPELOMA.

BY R. ELLSWORTH CALL.

THE collection of a large number of specimens of *Campeloma subsolidum* Anthony, in the Des Moines river, Iowa, in early August, presented opportunities to somewhat carefully study the coarser anatomy of the genus as exhibited in this species. The results of this study are herein given. It may be noted, as introductory, that an unexpected closeness of structure to that of the foreign genus *Paludina* was developed, and, further, that the general diagnosis given by Dr. Stimpson[1] will need some slight emendation, particularly in respect to certain external characters, and in respect to the lingual teeth and the branchial laminæ.

*External Characters.*—In the living and recently dead animal the color of the foot-mass is light lead or bluish white. Viewed from above, the cervical lappets, foot, operculigerous lobe, tentacles and proboscis are further enlivened by irregularly scattered bright orange-yellow dots. These dots are, on the tentacles and proboscis, arranged in somewhat regular transverse rows, giving a barred appearance to each. These last-named organs are, moreover, marked by an abundant deposition of black pigment immediately under the cuticular membrane. The under surface of the foot, the crawling disk, shows, in living specimens, the large longitudinal pedal muscles. When these muscles contract, in the act of withdrawal into the shell, the anterior margin of the disk is reflected upwards and backwards over the proboscis and tentacles. This reflected portion is, as a whole, then bent backwards and downwards to be finally covered by the posterior portion of the foot, the upper surface of which carries the operculum. The whole mass is then withdrawn into the shell. During the period of reproduction, when the organs devoted to that function are in a condition of marked activity and distension, the animal, especially of the female, cannot be wholly retracted. In this respect it resembles most of our large *Helices*.

*Sexual Features.*—The sexes are readily distinguished, in life, by means of the right tentacle, which, in the male, is very much larger than its fellow and rather more curved outwards (Plate VII., Fig. 2,

[1] Smithsonian Misc. Coll., No. 144, p. 35, 1865.

and VII. of Fig. 1, in the text). Again, as appears below, the shells differ in certain particulars of corresponding dimensions.

The male seminal duct is displayed throughout nearly its whole length by clipping the mantle along the extreme left of the branchial chamber. The *vas deferens superior* (IV., Fig. 1) arises from a point on the anterior left third of the testis (II., Fig. 1). This latter organ is placed immediately under the right duodenal fold of the intestine (I., Fig. 1). It is about three times longer than wide, and whitish in color. The *vas deferens superior* after passing anteriorly to a point near the anal extremity of the intestine is suddenly bent obliquely backwards and traverses the floor of the branchial chamber for a short distance, but soon turns forward again at a somewhat acute angle. At this point (III., Fig. 1) is the prostate. The *vas deferens inferior* (V., Fig. 1) is rather long, narrow, and nearly straight, and is continued along the floor of the right tentacle to the verge (VI., Fig. 1). The right tentacle thus becomes an intromittent organ in the process of copulation. This tentacle is somewhat flattened above, presenting, in cross section, an elongated ellipse. It is somewhat less in length than its left fellow, and is rather more curved outwards.

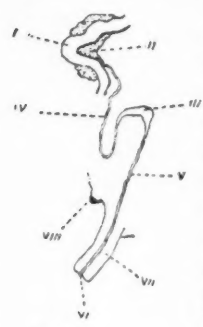

Fig. 1.

In the gravid female the gestatory sac (Plate VII., Fig. 5, c) occupies the greater portion of the body whorl on the right side. It is readily distinguished in the living specimen by the greater deposit of black pigmentary matter in its thin outer walls. Anteriorly the sac opens into a rather small duct, the mouth of which is prolonged into the branchial chamber about 2 to 2.5 millimetres (b, Plate VII., Fig. 5). This duct is guarded at each extremity by rather powerful sphincter muscles. Anteriorly the walls of the gestatory sac are slightly thicker and are modified into longitudinal folds or rugæ leading towards the duct. These possibly are of use in guiding the extrusion of the young.

During the summer and fall months, and often also in hibernating specimens, the gestatory sac is crowded to distension with young, in various stages of development (Plate VII., Fig. 5, c). Those most anterior are, in early August, nearly or quite through their prenatal growth, and are less closely crowded upon one another

than are those in the rear portion of the sac. All the young in the anterior portion possess shells. The shell of the young at

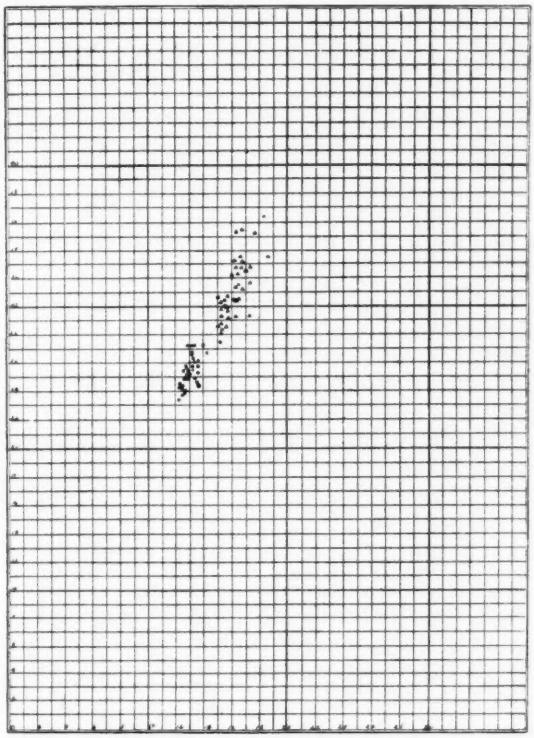

FIG. 2.

this stage is devoid of *colored* epidermis, is crystalline white, and possesses from 2 to $2\frac{1}{2}$ complete whorls. The apex is very short and blunt, the first whorl being nearly uniform in diameter throughout its length, while the body whorl is very large, comprising fully nine-tenths the entire bulk of the shell. The darker tentacles and the black eyes at their outer base are readily seen through the substance of the shell. The average dimensions of a dozen or more young examined were, for length 3.5 mm., for diameter 2.96 mm. The embryonic whorls never, so far as experience goes with mature specimens with completely preserved apices, acquire the characteristic green epidermal coloring.

The number of young is variable, the large mature specimens containing, as might be expected, the greater number of young shells. Twenty specimens were carefully examined with a view to this feature, with the following result:—

| Specimen. | Young. | Specimen. | Young. | Specimen. | Young. | Specimen. | Young. |
|---|---|---|---|---|---|---|---|
| 1 | 36 | 6 | 59 | 11 | 29 | 16 | 47 |
| 2 | 42 | 7 | 52 | 12 | 25 | 17 | 42 |
| 3 | 51 | 8 | 32 | 13 | 49 | 18 | 64 |
| 4 | 35 | 9 | 32 | 14 | 58 | 19 | 63 |
| 5 | 41 | 10 | 38 | 15 | 34 | 20 | 50 |

These twenty individuals, therefore, present an average of forty-three young.

Aside from the tentacular differences which exist between the male and female, both tentacles of the latter being uniformly subulate, a further sexual difference appears in the greater size and somewhat more globose character of the female shell. Coördinated with this difference in dimensions is the more shouldered character of the whorls in the female specimen, a difference connected with the position and necessarily large size of the gestatory sac. The males are more regularly conical, with rather less oblique aperture, and are of considerably less globose appearance than are the females. This difference was supposed to be of value in determining the sex when only the shell was at hand. To test it as a sexual differential character, thirty-six of the largest males and an equal number of the largest females were selected from a finding of more than a gallon of *C. subsolidum*, taken on August 6, 1887, and were carefully measured. The results appear in the following:—

TABLE OF DIMENSIONS. MALES.

| No. | I. | II. | No. | I. | II. | No. | I. | II. |
|---|---|---|---|---|---|---|---|---|
| | mm. | mm. | | mm. | mm. | | mm. | mm. |
| 1 | 25.88 | 12.80 | 13 | 24.94 | 12.92 | 25 | 24.22 | 12.36 |
| 2 | 26.00 | 13.00 | 14 | 24.52 | 12.38 | 26 | 25.14 | 13.00 |
| 3 | 27.25 | 13.32 | 15 | 26.10 | 13.51 | 27 | 23.90 | 12.70 |
| 4 | 26.06 | 13.31 | 16 | 30.76 | 15.00 | 28 | 26.62 | 13.12 |
| 5 | 27.22 | 12.90 | 17 | 27.34 | 14.00 | 29 | 23.94 | 12.86 |
| 6 | 26.80 | 13.14 | 18 | 24.95 | 13.36 | 30 | 25.84 | 12.92 |
| 7 | 27.47 | 15.08 | 19 | 27.32 | 13.04 | 31 | 26.16 | 13.29 |
| 8 | 25.50 | 12.66 | 20 | 26.86 | 14.20 | 32 | 25.16 | 12.92 |
| 9 | 24.48 | 12.54 | 21 | 25.76 | 13.62 | 33 | 25.50 | 13.60 |
| 10 | 25.54 | 12.90 | 22 | 25.20 | 13.61 | 34 | 23.36 | 12.24 |
| 11 | 26.28 | 13.40 | 23 | 24.82 | 13.50 | 35 | 24.95 | 12.88 |
| 12 | 24.14 | 12.50 | 24 | 28.32 | 15.22 | 36 | 24.00 | 12.64 |

I. = length in mm. II. = diameter in mm.

TABLE OF DIMENSIONS. FEMALES.

| No. | I. | II. | No. | I. | II. | No. | I. | II. |
|---|---|---|---|---|---|---|---|---|
| | mm. | mm. | | mm. | mm. | | mm. | mm. |
| 1 | 36.44 | 18.40 | 13 | 35.50 | 17.72 | 25 | 29.20 | 16.22 |
| 2 | 30.00 | 15.68 | 14 | 30.30 | 16.29 | 26 | 29.10 | 15.80 |
| 3 | 29.80 | 15.16 | 15 | 32.37 | 16.40 | 27 | 32.88 | 16.34 |
| 4 | 32.12 | 16.00 | 16 | 30.50 | 15.56 | 28 | 30.24 | 16.60 |
| 5 | 32.92 | 16.88 | 17 | 28.50 | 15.68 | 29 | 23.94 | 12.86 |
| 6 | 30.26 | 16.21 | 18 | 33.14 | 16.80 | 30 | 25.84 | 12.92 |
| 7 | 30.44 | 15.50 | 19 | 29.49 | 17.32 | 31 | 26.16 | 13.29 |
| 8 | 33.62 | 18.62 | 20 | 30.00 | 15.50 | 32 | 25.16 | 12.92 |
| 9 | 35.28 | 17.62 | 21 | 31.64 | 17.36 | 33 | 25.50 | 13.60 |
| 10 | 29.88 | 15.72 | 22 | 33.14 | 16.16 | 34 | 23.36 | 12.24 |
| 11 | 33.50 | 16.60 | 23 | 35.40 | 17.32 | 35 | 24.95 | 12.88 |
| 12 | 32.50 | 17.00 | 24 | 30.42 | 16.56 | 36 | 24.00 | 12.64 |

I. = length in mm. II. = diameter in mm.

A comparison of ratios shows the numerical values of differences, as follows: Length of male to its diameter, $\frac{25}{13}\ \frac{789}{234}$; length of female to its diameter, $\frac{31}{16}\ \frac{35}{127}$; length of female to length of male, $\frac{31}{25}\ \frac{35}{789}$; diameter of female to diameter of male, $\frac{16}{13}\ \frac{127}{234}$. The differences of lengths is 5.561 and of diameters 2.893. It would appear, then, that this degree of difference may be of diagnostic value in the matter of sex. The diagram, Fig. 3, is designed to present this sexual peculiarity in a graphic form. The marginal numbers represent millimetres. The ordinates represent the lengths, and the abscissas, which have the same scale, represent diameters. The circular conventional sign represents the male and the triangular character the female specimen. The average dimensions of each group are represented by the open conventional sign with its distinguishing sex mark conjoined. It will be seen that while the dots fall into two pretty well-defined groups, the range of greatest variation follows the ordinates, and that this range is comparatively greater for the female than for the male form. In other words, the males are more constant in lengths and vary less in diameter, while, for the female form, differences in length are measurably compensated by corresponding increase in diameter.

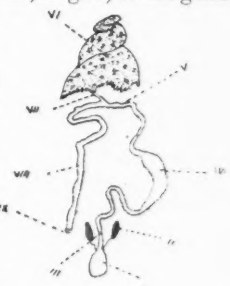

Fig. 3

In connection with this character it may not be altogether amiss to call attention to certain so-called species which have been based upon the males of *C. subsolidum*. They are *Campeloma milesii* Lea,

*C. coarctatum* Lea and *C. exilis* Anthony. The same unfortunate cause of synonomy has led, in the genus *Unio*, to the erection of more than a hundred spurious species, in certain cases the females serving as a basis for not less than five specific names. The *form* of a shell in so extremely variable a group is certainly a very misleading character.

*Digestive Organs.*—The buccal cavity opens on the middle side of the rather short proboscis near its base. Near the œsophagus (III., Fig. 3) and upon the floor of the buccal mass lies the radula. This is a small, narrow, chitinous organ, beset with numerous transverse rows of teeth, arranged according to the formula 3.1.3 (Fig. 3, Plate VII., and Fig. 4). The dentition is therefore tænioglossate. On either side, near the posterior end of the buccal cavity, open the ducts of the salivary glands (II., Fig. 3). These are small racemose paired glands, dirty white in color, and lie close upon the œsophagus. Including their ducts, they are about 1.5 mm. in length, and nearly or quite .25 mm. in width. The œsophagus is long, irregularly winding, placed upon the floor of the branchial cavity, and opens, into a somewhat capacious stomach (IV., Fig. 3), near the middle of the whorl next the body-whorl. The intestine is of nearly the same size as the œsophagus, and does not enlarge until the opening of the biliary duct is passed (V. and VII., Fig. 3). At this point it is coiled upon itself to the left, forming what may be called the right duodenal fold, immediately under which lies the testis, as stated above. Turning again to the right, it is there directed forward, becomes slightly enlarged, forming the rectal portion of the intestinal canal (VIII., Fig. 3), which opens into the branchial cavity near the margin of the mantle on the right side (IX., Fig. 3). The liver (VI., Fig. 3) is a very large glandular body, completely filling the first two and a half to three whorls of the shell. Its contents are discharged into the duodenal portion of the intestine near the position of the heart. In color it is orange-red, and is somewhat larger and darker in the male than in the female form. This organ, like all other portions of the animal which lie next the shell, is inversed by a thin membrane, containing pigmentary matter, the membrane itself being a continuation of the mantle.

*Respiratory Apparatus.*—The branchial cavity is large, extending backwards throughout nearly the whole length of the body-whorl. It opens towards the right side, its left margin being just

above the base of the left tentacle. The chamber is somewhat less in size in the gravid female than in the male, a fact the explanation of which probably lies in the distension of the gestatory sac and its consequent encroachment upon the branchial space. The chamber narrows rapidly posteriorly, and becomes laterally constricted. From its upper and left side walls is pendant the ctenidium (Plate ? Fig. 5, Br). This organ consists of a single row, containing a great number of thin elongately triangular plates, connected above with the branchial vein. The right edge and lower extremity of each plate is free, and each is constantly bathed with water. The plates become smaller as the rear end of the chamber is reached; they are yellowish white in color, and are furnished with abundant cilia. The blood, which is aerated in these plates, is white.

The attention of students with proper appliances at command is directed to these molluscs in respect to their embryology, nervous system, minute anatomy of the reproductive organs, myology and circulatory system. Only the crudest observations on these points were possible under the conditions which were presented to me, and such facts as were ascertained are repressed in the hope that some other one will be able to complete the work here outlined.

*Explanation of the Plate.*—× $\frac{4}{3}$. All the figures, save Fig. 2, are drawn from the female. The mantle is clipped along the left margin of the branchial cavity.

Fig. 1. Female, Fig. 2, male individual.
Fig. 3. A single transverse row of teeth.
Fig. 4. Odontophore, natural size and very greatly enlarged.
Fig. 5. Anatomy of the branchial cavity with related organs.
a. Rectum and anus.
b. The opening of the gestatory sac, c.
br. The ctenidium.

The figures on the plate were drawn by Mr. H. A. Pilsbry from dissections made by him. Those in the text are drawn, somewhat diagrammatically, by the author, from nature.

# THE WILD CATTLE OF GREAT BRITAIN.

BY R. C. AULD, F.Z.S.

THERE has always been a great deal of interest manifested in the lay as well as in the scientific mind as to the wild cattle of Britain. The British Association appointed a committee to inquire into the condition of these herds, and at a late meeting this committee's report was presented by Canon Tristram. The herds at present existing were stated to be those at Chartley, Chillingham, Cadzow, Somerford, Blickling, and Vaynol. The last (near Carnarvon) does not seem to be mentioned by Storer or Harting.

The committee thought it would be extremely interesting if the noble owners of the three ancient herds—Chartley, Chillingham, and Cadzow—would co-operate with some other owner of a large park, if haply such could be found, willing to undertake the following experiment: All calves which would ordinarily be converted into veal or steers should, instead, be sent to build up a new herd, which, combining the blood of the only remaining ancient herds and with no artificial selection exercised, might be expected to revert more nearly to the aboriginal wild type than could be achieved in any other way.

The care with which the European bison is preserved in Poland, under the especial protection of the Czar of Russia, has been noted. The interest of the Russian and British "quality" from the earliest date in taking means to preserve these aboriginal animals is most praiseworthy and contrasts favorably with the apathy of Americans in regard to their aboriginal bison. Why should not the American Association take this matter in hand, and, ere too late (if not, indeed, too late already), secure from government a regional reservation and sufficient enactment that would ensure the preservation of this interesting species?

Some of these wild British herds were horned; most were polled. Some of them became domesticated; most of them became extinct. Their antiquity cannot be limited; they were among the original cattle of the island—indeed, descendants of the Uri that roamed into this corner of Europe before it became an island.

But some do not care to trace the origin of British cattle further than the historical dates of the subjugation of the various parts of

the island by Roman, Norseman, Dane, and Norman. The student who has devoted himself unremittingly to this historical aspect of the question is the Rev. G. Gilbert, of Claxton, Norwich. The views of this gentleman, who has paid much attention to the history of the polls, are worthy of study, and it is here appropriate to refer to them. I do so by quoting extracts from several communications I have been favored with from him: "My own opinion," he writes (and he begins by referring to the Aberdeen poll) "is that there was in Scotland, on the east coast, long before the short-horn struggled into notoriety, even in England, herds of polled cattle which owed their best qualities of hardiness and combined power of producing good beef and milk from the same animal to that very breed which gave these properties to the short-horn—*i.e.*, to that big polled white which seems to me to have come to Great Britain above eight hundred years ago with the Baltic Rovers, and to have existed in considerable numbers, in places widely apart, down to the beginning of last century without there having been any recent connection.

"The polled herds in England, Scotland and Ireland all held, before there was much intercourse between cattle-men, one common infusion, and that was the blood of the whites from the far north. Those white cattle seem to have parted with their color more readily than they parted with their thick muscle (*i.e.*, lean flesh), tending to milk, hardiness, and polled heads. (Of course recently, since 1750, there have been large transmissions of English cattle to Scotland, and *vice versâ*, and also of English and Scotch cattle to Ireland. I doubt if ever before this century either England or Scotland has ever borrowed sires from Ireland, though England has borrowed for quite a century Scotch sires, and Scotland English sires for the same period.) Gradually, at the end of the last century, distinct types of those county herds which all had some ingredients common and, each, some distinct element, got more or less fixed, until they reproduced themselves, as they do now, even in non-pedigree stock, with tolerable certainty. I fancy the last half of last century saw the formation of *all* British breeds now existing in distinct form. The short-horns and all the polls hold the largest infusion of the big white, the Midland and Hereford hold the most of the old South Europe longhorn, whilst the Devon, Kerry, and small North Highlander hold the most of the type known as *Bos longifrons*, all of which seem to have been the first domestic cattle in Great Britain and Ireland.

"I think that very likely *Bos urus* was already in both islands as a wild beast. But *Bos urus* and the big white are not the same. The big white was domesticated from the first, and probably came, as you yourself suggest, from the polled breeds of India. I am trying to gather all the evidence I can get to show what the last thousand years may have done to make British breeds what they are, and thence to infer what the thousand years before that may have contributed. The long-horn, as I fancy, came over with the Romans, and the white polls with the Danes long subsequently. It was through the working of this Danish introduction that all the polled breeds took their rise. I fancy during the Wars of the Roses in England and up to the time of the union with Scotland breeding cattle was pursued without any aims beyond these:—

"1. Certain districts tried to get big oxen for labor.

"2. Other districts avowedly preferred the smaller cattle, as better able to live in the huts with their owners.

"Through these influences, up in the mountains, the smaller or (*Bos longifrons*) North Highland type kept its ground. In the plains and near the towns the cattle became larger, partly from selection, partly because their veins were filled with many intermixtures. Bulls would come from the south as baggage animals in the track of returning armies and would be crossed with and enlarge the native cows. So all through the richer lands on the south and east side of Scotland there was not any fixed type for a century or two as there was in the north and the west. But still it was these cattle of the plains (I believe) which originated the 'doddies.'

"Wherever the Dane (white polled) extended itself it broke the colors—first conveyed the disposition to throw occasional polled calves. The disposition to produce polled calves and the mixing colors are evidences of latent (perhaps very remote) connection with the Danish introduction.

"It would be absurd to suppose that the Danish introductions were all that we now regard as 'pure bred'—*i.e.*, all alike and entirely of one descent. Probably there were a few cherished white herds in the north of Europe kept to one type; but, more likely, the cattle were early mixed through the predatory habits of the red-rovers. The Danes may have brought over here a few pure whites, gifts to their chiefs; but they brought over far more which were carried off by their vessels from shores on which they touched

after leaving home but before they reached Britain; so that the Danish additions to Scotch and English breeds were not one but many. Still, it was among their introductions that their tendency to polled calves was brought to this island, and it came from the far north, where, even in the days of Herodotus, its existence was noticed. Before Herodotus we only find traces of it in rock sculpture in the far Orient. Thousands of years ago the polled form was developed (as I think) in India, and it worked its way thence to the shores of the Baltic overland through centuries of slow advances. From the Baltic it found its way to England and Scotland. I do not think from England to Scotland, or *vice versâ*, but that the same set of sea-rovers introduced cattle with polled tendencies into both countries almost simultaneously."

It should be stated that the above was written before the publication of Victor Hehn's work (already noticed), in which the latter traces the polled cattle of Western Europe to Scandinavia and the White Sea. Mr. Gilbert takes the history of these continental polls a step farther, following them, it will be seen, to the eastern coasts of Great Britain, landing them with the Baltic invaders, to become the determining element in forming the polled races now existing in Great Britain, whether north or south of the Tweed. "These," writes Mr. Gilbert, "probably were our latest introductions." Hence the polled breeds on the eastern coast would have had prior origin. The various British and foreign forms Mr. Gilbert thus indicates must be studied as a whole in connection with the appearance in Europe of the various hordes who reached it by two routes: *First*, by the northern route, descending upon Mid-Europe from the shores of the Baltic. *Second*, by the southern route, making their way upward, men and cattle, along the shores of the Mediterranean.

The question has raged to which species these wild cattle belonged? Professor Low says of these animals: "The wild breed, or, as it may be termed when domesticated, the white Forest breed —identical with the ancient Urus—is still preserved in a few parks, where the animals, herding and breeding only with one another, retain their pristine characters. Numbers, however, existed in the domesticated state in Wales until late in the last century. . . . Scattered individuals are yet to be met with, as in the County of Pembroke, in no respect distinguishable from the wild cattle of the parks."

J. E. Harting, F.L.S., F.Z.S., the latest scientific authority who has given attention—and that in a most thorough manner—to the wild white cattle, says, in his *British Animals Extinct*, page 214: "The weight of scientific opinion, however, seems to favor the view that these wild cattle were descended from the Urus, either by direct descent through wild animals from the bull, or, less directly, through domesticated cattle deriving their blood principally from him."

Rütimeyer, Nillsson, Lyell, Darwin, and Boyd-Dawkins believe that our wild white cattle are descended from the Urus in one or other of the two ways above indicated; while Owen and Dr. J. A. Smith ("Notes on the Ancient Cattle of Scotland," in *Proc. Soc. Antiq. Scotl.*, Vol. IX., p. 587) hold a different view, and consider that *Bos primigenius* became extinct throughout the whole island in prehistoric times. "This may have been the case," says Harting, "in southern parts of Britain." But he indicates conclusively that this could not have been the case in undisturbed Caledonia.

In Ireland "no trace of these wild cattle has been discovered, although remains of the smaller *Bos longifrons* have been procured from some localities."

The late J. Gibson, of the Museum of Science and Art, Edinburgh, Scotland, writing on "Cattle" in the *Encyclopædia Britannica* (ninth edition), says: "*Bos taurus*, var. Scoticus, makes the nearest approach of living forms to Urus, represented by Cadzow, Chillingham, Lyme, and Chartley herds."

These herds have been preserved since early historic times. The pictures by famous artists—such as Ward, Landseer, and others—represent them faithfully.

### BRITISH WHITE POLLED CATTLE.

Rev. John Storer's work[1] is the most exhaustive we have on the subject of the wild white cattle of Britain, while J. E. Harting, F.L.S., F.Z.S., editor of the *Zoologist*, has published a more concise account.[2]

The following is a tabular view of the various herds:—

[1] Wild White Cattle of Great Britain.
[2] Extinct British Animals.

*British Wild White Cattle* (*Bos urus*).

I. Horned Variety.

1. Sub-variety, having black ears, but no black tip to tail.
   Chartley, Drumlanrig,[1] and Athole[1] Herds.
2. Sub-variety, having red or brown ears, but no black tip to tail.
   Chillingham and Lyme[1] Herds.

II. Polled Variety.

*English Herds.*

(*a*) Somerford,[2] Cheshire—Black points.
Wollaton,[2] Nottinghamshire—Black points.
Burton Constable,[2] Yorkshire—Black points.

(*b*) Gisburne,[2] Yorkshire—Red or brown points.
(Whalley Abbey.[2])

(*c*) Middleton,[1] Lancashire—Black and dark brown or red points.
Gunton,[1 2] Norfolk—Black and dark brown or red points.
Blickling,[2] Norfolk—Black and dark brown or red points.
Woodbastwick,[2] Norfolk—Red and dark brown points.
Brooke,[1 2] Norfolk—Black and brown or red points.

*Scottish Herds.*

(*d*) Ardrossan,[1] Ayrshire—Black and brown or red points.

(*e*) Hamilton, Lanarkshire—Black and brown or red points.

The polled herds, it will be seen, have been and are still the more numerous, and a short description of each is appended.

ENGLISH HERDS.

I. The Somerford Park Herd, near Congleton, Cheshire, is a domesticated herd, but its cattle are very characteristic, having all the peculiar features of the White Forest breed. It is certainly of great, though unknown, antiquity, their owner, Sir Charles Shakerly, saying: "We have no history of how they came or how long they have been here. I am of the third generation which has

[1] Extinct. [2] Domesticated.

known nothing about them. The tradition is that they have been here two hundred years." It is probably the best representative extant of the hornless and tame variety of the originally wild white breed. It is of great importance, as showing what and of great value the numerous ancient herds of white polled cattle were. Perfect and in working order, it gives an excellent idea of what the Gisburne (now extinct) and the Hamilton (now horned) cattle were originally. This herd seems to be a connecting link between the domesticated white cattle and the wild, and also between those which had horns and those which were polled. An experienced eye cannot fail to trace a very close resemblance between them and the wild horned breed at Chartley. The park is well timbered, the quality of the soil and grass very good, though in the heart of the ancient forest region. The milking properties of the cows are good naturally, and have thus been fully developed. The white color of the cattle is accompanied by black points, and sometimes spots on the neck and body. They are handsome and very uniform as to color. They may have been derived from some ancient monastery, one of which, Vale Royal, only twelve miles distant, has a somewhat similar breed. Storer gives a very full account of them as they existed at the time of his visit to the herd in 1875.

FIG. 1.—Head of White Bull, with black ears and muzzle, of Gunton Herd. (From Storer's *Wild White Cattle of Great Britain.*)

II. WOLLATON HALL HERD,[1] the property of Lords Middleton, situated three miles west from Nottingham, has become extinct during the last fifty years. It was generally known as "the Old Park Breed," which indicated them to be an original and very ancient race. They were polled and had black points. The originally wild nature of the herd interfered with its thorough domestication, in-breeding hastening its extinction, as in many other park herds. They were of specially large and symmetrical proportions. Their pasturage, of considerable extent, was fairly good, though not particularly rich. They are supposed to have become enclosed from the grand old forest of Sherwood. The Wollaton (Somerford),

Chartley, and Lyme (these last two horned) formed the southernmost group of the ancient white cattle, and all were in tolerably close proximity.

III. The Gisburne Park Herd,[1] the property of Lords Ribblesdale, situated in the Valley of the Ribble, in the district of Craven, West Riding of Yorkshire. This herd became extinct in 1859, the cause being in-breeding. They were described by Bewick in 1790 as perfectly white, except the insides of the ears, which were brown. They were thick and deep and as large as any short-horns, had mellow hides, and were excellent milkers. They are said to have been brought originally from Whalley Abbey, being enclosed from the indigenous wild cattle which occupied the great forests of Lancashire. Professor Boyd-Dawkins preserves in the Museum at Owen's College, Manchester, under his charge, the skull of "the last bull" of this herd. In a letter to me, referring to this, he says: "The Gisburne cattle come nearer to the Chillingham cattle than any other breed, being white in color, with reddish-brown inside their ears. The only stuffed specimen and skull of this breed, now extinct, are in the Museum under my charge at Owen's College, Manchester. The Gisburne breed represents, like the Chillingham, the domestic cattle of the Urus type which have never been confined in fields, and which, therefore, by contrast with the more domesticated animals, are frequently termed wild. The stuffed specimen above referred to is a cow, low in stature, with a prominent protuberance on the forehead, like that found in the Galloways. The skull, also hornless, and belonging to a bull, labelled 'The last of the ancient breed of wild polled cattle kept at Gisburne Park, Yorkshire, killed 11th November, 1859, and presented by the Rt. Hon. Lord Ribblesdale,' proves that the male was hornless."

IV. Middleton Hall Herd,[1] the property of the Asshetons, Baronets of Middleton, near Manchester, Lancashire, was quite an original one, of very ancient origin. They descended from the wild bulls that invested Blakele, close to Middleton Hall. They gave origin to the Gunton herd, in Norfolk. Dr. Leigh mentions them in 1700 (*Natural History of Lancashire, Cheshire, and the Peak of Derbyshire*, Book II., p. 3), but the origin he traces for them—from the Highlands of Scotland—must be regarded as a mere surmise.

V. Gunton Park Herd,[1] the property of Lords Suffield, situated in the northeast portion of Norfolk. The Gunton cattle

were brought from the Middleton herd and were a continuation of it. The cattle became thoroughly domesticated. They had black, or, at any rate, dark brown, points. They were deep milkers. They gradually disappeared; but in their day they had great influence on the cattle of the district. The Rev. George Gilbert confirms this, and also as to their size. They "stood up like dray-horses," while they could be made enormously fat.

VI. Blickling Hall Herd (Norfolk) is a domesticated herd still existing. It was derived from Gunton. The cattle had black points. They were considerably affected by the rinderpest, previous to which they were very useful in the dairy. Rev. George Gilbert, who gives a full account of them in Storer's work, says the cows are not above the average of the Galloway and are below that of the Aberdeen. The following is the latest I have seen in reference to this herd, and shows that it contains good material: "A remarkable novelty at this Norfolk show was an exhibition of several animals from Lady Lothian's unique herd of white polled cattle, the beasts having black ears and points. A bull took a first prize, beating several fine Herefords. This curious herd has been kept at Blickling since the reign of Charles II., and it represents one of the oldest types of cattle in the world." (London *Truth*, July 7, 1887.)

VII. Woodbastwick Herd, the property of Mr. A. Cator, Norfolk, a domesticated, still existing herd, derived from Gunton. The cattle had red points. They were large, would fat to great weight, and had large manes. They were kept pure up to 1840, when different crosses were had resort to. It is of importance to note that Mr. G. Gilbert states: "It is impossible not to notice that the white polled cattle, both at Blickling and Woodbastwick, are quite distinct (in appearance) from the Norfolk and Suffolk. They are as distinct from the local polled variety as possible,"—and he also includes the Galloway and Aberdeen.

VIII. The Brooke House, or Kerrison Herd[1] (Norfolk), were a domesticated herd before they became extinct. They were derived from Gunton, and had black points. Rev. George Gilbert, by relationship with the owner of this herd (Sir Roger Kerrison), is very well acquainted with it. He states they stood very high, and that there are traditions of a similar breed of white polled cattle in the Downham district occasionally, even now, polled steers of gigantic size being occasionally found. He saw one in 1877 which

certainly stood six feet high. These cattle may have also been derived from the stock of one of the monasteries of the Premonstratensian Order, which had privileges over certain manors, including Brooke and Kustead, in both of which parishes Sir Roger Kerrison's ancestors lived. Mr. Storer, speaking of this herd, concludes his account thus: "It demonstrates by the clearest evidence how strong has been the influence of the wild forest breed upon our domestic cattle, how wonderfully persistent is the type, and how it reproduces itself under the most unlikely circumstances—often, perhaps, when its very existence is altogether unsuspected."

IX. BURTON CONSTABLE HERD.[1]—This herd is situated in the Holderness or East Riding District of Yorkshire. Storer is not very definite about this herd as to its character. It appears to have been a polled herd. Bewick (1790) gives a brief account of it. He states it was carried off "a few years ago by a distemper." These cattle were much larger than the Chillingham horned cattle, many weighing sixty stones (eight hundred and forty pounds).

SCOTTISH HERDS.

X. ARDROSSAN HERD[1] (Ayrshire), property of the Lords Eglinton, was mentioned by Sir John Sinclair in 1814 as one of the then few remaining examples of Caledonia's ancient breed. It survived till about 1820. They had black points. They were enclosed about 1750. They were traditionally believed to have been horned when introduced to Ardrossan. They were certainly all, or very nearly all, polled within the memory of man. The cause of their becoming hornless was the result of an introduction from the polled Hamilton herd. In other respects they seemed to have differed little from the Caledonian wild cattle, except that perhaps they were smaller. Mr. George Robertson, author of several such works, in his *Description of Cuningham and Ayrshire*, published 1820, says: "They are altogether wild; they have no horns; they are distinguished by the name Caledonian," being an offshoot of the older Hamilton.

FIG. 2.—Head of Young Bull, *Bos scoticus*. (From Milne Edwards' *Zoology*.)

XI. THE HAMILTON HERD (Lanarkshire), known also by the names Cadzow and Chatelherault. Mr. Brown, chamberlain to the Duke of Hamilton, in Jesse's *Natural History*, describes

the Hamilton Urus as having a body dun white, with black points, and the cows as seldom having horns. Sir John Orde says that they were anciently "all polled." Youatt speaks of them as being polled, beginning his account of *The Polled Cattle* with a description of them. Mr. MacGillivray, in his *Essay on the Present State of the Outer Hebrides*, says: "A whitish dun color is also pretty frequently seen, not unlike that of the original wild cattle of Scotland, both the horned breeds at Chillingham, and the polled one at Hamilton, and it is remarked that in all their traditions or fables of what are called fairy cattle this is the color ascribed to these animals." At the sale of the late Dr. Knox's collections a polled skull of the Hamilton wild ox was purchased by the late Professor Goodsir. It was labelled by him *Urus scoticus*, and added to the Anatomical Museum of the University of Edinburgh. Some oxen from this herd were exhibited not many years ago at one of the shows of the Highland Society, and were similarly described. In Milne-Edward's *Zoology*, 1863, Figure 256, the "Head of young Scotch bull, *Urus scoticus*, or wild ox of Caledon, Cadzow," is polled. (See Figure 2.) The skull is labelled "White Ox of Scotland." From this testimony it is pretty clear that the Hamilton herd was originally polled. So late as 1852, W. C. L. Martin, in his book on *Cattle*, says the Hamilton's "are larger and more robust than the Chillingham. . . . The cows, and also the bulls, are generally polled or hornless." And in 1862 Charles Stevenson wrote: "In the herd of wild cattle in Hamilton Park polled bull and heifer calves frequently appear. Latterly no bulls are kept which have not the short white horn tipped with black; but there are a few cows and heifers polled. It may be mentioned that this breed was originally both polled and horned and that both types reappear, notwithstanding the care taken to breed them of a uniform type as to horns and color." Thus is shown the gradual change from *polled* to *horned*. The reason given of their having become horned is stated by Sir John Orde, Kilmory, Argyllshire, to have been from a Highland bull having accidentally got within the park. Some horned calves were produced, and by subsequent selection the herd had got horns generally, the horned character being preferred—likely from the fondness for the grandly-horned Highland cattle, which make such a picturesque feature of the Highland glens and straths. But their horns are "short," not "long." These celebrated polled cattle, variously known as the

Cadzow, Hamilton, or Chatelherault—the first name being the name of their forest home, the second being one of the Scotch titles of the ducal owners, the third being their French title—are thus generally regarded as being the remains of the ancient breed of white cattle which was found on the island when the Romans first visited it, and which they represent as then running wild in the woods. The universal tradition in Clydesdale, where they were called "Caledonian," is that they have been at Cadzow from the remotest antiquity, and the probability is that they formed part of the establishments of the early British and Scottish kings. Sir Walter Scott's stirring ballad on the hunting of the wild bull is too well known to need repetition.

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## THE CALIFORNIA GRAY WHALE.

(*Rhacheanectes glaucus* Cope.)

BY JOHN DEAN CATON.

I FIRST saw this interesting animal eighteen years ago, when running down the coast on the steamer Orizava. We then met them in considerable numbers when on their migration north. We were running but a few miles from shore, and generally observed them on the seaward side, but sometimes on the shore side. Sometimes they appeared quite close to the ship and did not seem to be much alarmed by the presence of the steamer. I have since taken pains to inform myself of the habits and mode of capture of this great sea mammal and think I may safely say that it is the most interesting of all the species of whale known to inhabit the great seas, perhaps because it is the best understood.

It does not inhabit the distant depths of the broad oceans but its habitat is confined to the coast line of the Pacific from Cape St. Lucas at the southern extremity of the peninsula of California to Behring sea and even into the Arctic ocean, where it sports among the icebergs of the north with as much apparent pleasure as it rolls and tumbles among the great breakers in its southern range.

If other species of whales are as strictly migratory as this we lack the evidence to prove it. If others wander about into different seas, and even go from ocean to ocean, they do not move with that

regularity and system which constitutes what we call migration. With these this habit is as regular as the recurrence of the season, and is no doubt as universal as is that of most aquatic birds.

Wintering in the south, this migration to the north commences in the spring, first with the males, who having no domestic duties or cares to detain them, leisurely proceed northward, and they are soon followed by the females with their young so soon as the latter are large enough to undertake the long journey. Not that either sex move in a body and together, for they are scattered along the coast for even months, though they generally move in schools of greater or less numbers, among which both males and females may occur. Undoubtedly the former were laggards, while the latter were of the advance of the females.

Of all the families of whales, of this alone has it been possible to study the breeding habits with satisfactory results.

Along the coast, in the southern part of their range, numerous lagoons are found indenting the shores, near the mouths or outlets of which, bars occur on which the surf breaks with great violence when the sea is rough, while the waters within are placid. These lagoons are the favorite breeding grounds of these whales, where they congregate in great numbers to bring forth their young, which occurs during the winter months, say from November till March. Although the fiercest fighters of all known whales it has not been known that they are quarrelsome among themselves. So far as known, peace and quiet prevails among all the members crowded together in the upper ends of these water enclosures or lying-in hospitals. But few males have been observed to intrude themselves into the privacy of these retreats. The period of gestation is said to be about twelve months, and from analogy impregnation takes place within a very few days after the young are brought forth. Eliott's exhaustive observations show that such is the case with the fur seals, whose period of gestation is the same. Indeed, this must be so, when the period of gestation nearly corresponds with the year, else there could be no regularity in the time when the young are brought forth, but it would occur irregularly at all seasons of the year.

Another peculiarity of this whale is its fondness for sport or play. While this habit is solitary it is distinctly manifest. Its favorite amusement is to sport in the breakers or the bars at the entrance to bays, lagoons and rivers, and the greater the breakers, the more do

they seem to enjoy them, for there they play and gambol about, increasing the foam by the use of their powerful flukes, sometimes fairly turning somersaults, while at others they will cease apparent exertion, allowing themselves to be rolled and tossed about, the passive sport of the angry waters.

Of all the known species of whales, this is the most cunning, courageous and vicious. So terrible is it, that with the old implements of harpoon and lance, but few whalemen would court an encounter with it, and it early received the name of the Devil Fish. I have no account that it ever maliciously attacked an unoffending object, yet when it found itself pursued where escape was difficult, even before it was struck, it has been known to turn upon pursuers and dash a boat to fragments with a single blow of its powerful flukes, and so has many a life been lost.

It was in the whale nurseries, in the retired lagoons, where the young were brought forth and nursed, for a considerable time after they were able to accompany their mothers for long distances out to sea, that the most terrible encounters occurred. The mother has a remarkable affection for her young, and will do and dare everything in its defence, hence the whalemen were cautioned not to strike the calf while the mother was living. If she would not resent a severe wound to herself, while there was yet hope for escape that she might live to nurse and take care of her offspring, when once her darling was injured her rage knew no bounds, and there was no escape from her but to run the boat into shallow water or upon the beach. It is said that when in port the masters of whalers, in convivial mood, each recounting his adventures and escapes, those among them who had ever pursued this whale, could silence all others when recounting the terrors of the chase, and would seek to rival each other in tales illustrating the ferocity and courage of the female when her young were in danger, and if the last in turn to come did not win the palm it was his own fault or rather his lack of inventive genius. This is the way the last one to relate his experience won the drinks. He said he was once pursuing an old cow whale, with a well-grown calf, and while he had cautioned the man in the bow not to touch the calf, the youngster presented so fair a mark that he could not hold himself and so let him have it. Knowing what would follow, he instantly ordered all hands to pull for the shore, which fortunately was not far off. As they saw the enraged dam bearing down upon them like a tornado when they reached the shore, they tum-

bled out of the boat and thought they were safe. But no, she pursued them on land as well, and never stopped till she had treed them all!

The danger of the pursuit was much lessened, and the chances of capture of these dangerous animals was much increased by the introduction of the harpoon-gun and the bomb-lance. By them the attack could be made at a safer distance, and the exploded bomb produced instant death.

The inshore habits of these whales made it possible for the natives to attack and capture them even with their rude implements but as I have met no account of this south of Washington Territory, and rarely except in the vicinity of the Strait of Fuca, it is not improbable that much of the belligerent disposition of the brute may have left him by the time he has pursued his migratory journey so far, and especially may the temper of the female have been improved when the defence of her offspring was no longer demanded. Their mode of capture was simple though ingenious, but could have only met with disaster in their southern breeding grounds. Their mode was to attack with a large number of canoes, each armed with several men and provided with a number of inflated bladders, or air-tight sacks made of skins; to each of these was attached a light strong cord, at the other end of which was an arrow When a whale was sighted, the swiftly-paddled fleet pursued and embraced every opportunity for hours to shoot their arrows into him, always throwing overboard the proper air sack. Soon these began to tell by impeding his course through the water and preventing him from diving to as great a depth as formerly and obstructing his progress when fleeing from his pursuers. Thus in a longer or shorter time he might be literally covered with arrows, and so obstructed and loaded down, so to speak, with the air sacks, that he became quite helpless and finally succumbed to his swarming enemies, when by their united efforts he was towed to the shore and utilized in their way. This was only rendered possible by the peculiar inshore habits of this species of the whale.

For many years this whale was hunted from large whaling ships, which were anchored at convenient places near those locations where observation had shown the animal was most likely to be found, and from the ships whale boats were sent out to hunt for the game, and when captured they were towed to the ship and treated in the ordinary way. But this was an expensive mode of maintain-

ing a whaling station, and as the objects of pursuit became scarce—notwithstanding the improved mode of capture by the use of the harpoon-gun and bomb-lance—the pursuit became unprofitable, when Yankee ingenuity proved equal to the emergency and shore whaling stations were thought of. These are built upon the shore in sheltered places, but commanding an extensive seaward view.

Convenient structures are erected and equipped with all necessary implements and apparatus, with boats and arms for the capture of the whale, and everything on shore for treating the captive when brought to the shore. Near the station was a high lookout upon which a watchman was stationed with a well-understood system of signals, by means of which he could telegraph the boats when far out to sea. Here the men built comfortable cabins where they lived with their families, and later, as the whales became scarcer, they could pursue other avocations when their time could not be employed in the pursuit of their prey, which intervals increased as the whales became less and less abundant, till now many of these shore stations have been entirely abandoned. Here, in Monterey, the first whaling station was established on shore in 1851, and later another was established, both of which did a successful business for years, but within the last few years they have been entirely abandoned. Some of the buildings still remain but they are fast going to decay, and the old whale boats may now be seen leaning up against the sheds useless and abandoned. So at Carmal mission, a few miles across the peninsula; the absence of the game has compelled its desertion, and this is now true of most of the many whaling stations along this coast which once flourished. The station near the mouth of the bay of San Diego, I believe, is still kept up; at least when I passed it three years ago I saw two whales were on the ways.

Altogether we may well fear that this interesting species of this great family may before many years become extinct, as did the sea cow (unless governmental powers shall interpose to save them), which existed in incredible numbers about Bering Island when the great navigator was cast upon it, and where he found his grave in 1741.

The California whale may make a bolder and harder struggle for existence than did the Rhytina, but it is rapidly going to utter extinction. While other species of the whale family have greatly diminished in numbers in all waters, still their habits protect them from final destruction. They have a wider range and cannot be

slaughtered on any exclusive breeding grounds. Here their nurseries are limited to particularly favored places which are known and accessible to all who choose to murder them, and it is a little remarkable that the State of California has not, long since, by stringent laws protected them, at least in the nurseries within her borders. If their capture were confined to the open waters of the ocean and to a reasonable distance from the mouth of the lagoons in which they breed, we might well hope to see them multiply rather than fade away to final extinction. Certain interests encouraged the extinction of the vast herds of buffalo which once roamed over the plains and even the forests of our country, that the ranchmen might have better pasturage for their stock, but no interest can be promoted by the destruction of this whale while great interests would be subserved by its protection and increase. Other animals are protected which are of no practical value except as mere spectacles, while their existence involves a positive loss by the destruction of vast numbers of food fishes.

I might have stated before, that the California whale, though not the largest of the family, is of a good size, the largest measuring forty to fifty feet in length, though the average is considerably less than this. They are fairly robust in form and well covered with fat. They furnish no whalebone, but they produce from twenty to seventy barrels of oil, which, though not of the best quality, commands a good price in the market.

Solitary individuals of several other species of whales are frequently taken at the shore stations along this coast.

## EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

The bill lately introduced in the Senate by Senator Beck to provide for a National Zoological Park at Washington, "for the advancement of science and the instruction and recreation of the people," is certainly a step in the right direction, and one which might well have been taken long ago. As might be expected, the plan receives the unqualified endorsement and support of the Smithsonian Institution and National Museum, as indeed it must that of all scientists, friends of science, and the general public throughout the country.

The bill provides for an institution which shall be founded on a grand and liberal scale, and fully in keeping with the wealth, dignity and intelligence of the nation. The site is to be selected on Rock creek, just beyond the city limits, which would make the entrance to the grounds only a trifle over two miles from the Executive Mansion. The proposed site is one of great beauty, and even grandeur, for at two points high walls of rocks rise out of the picturesque valley to a height of over eighty feet.

The creek itself is a beautiful stream of very respectable proportions, describing a perfect letter S through the site to be chosen, and aside from its picturesque features it would afford unrivalled facilities for the care of aquatic mammals and birds of all kinds. Nearly the whole tract is covered by a fine growth of forest trees which, unless afforded immediate protection, is liable to be swept away by reckless real estate vandals.

It is proposed that the Zoological Park shall be established by three commissioners, the Secretary of the Smithsonian Institution, the Secretary of the Interior and the President of the District Board of Commissioners, and when fairly established it shall be turned over to the perpetual custody and care of the regents of Smithsonian. With the unrivalled facilities already enjoyed by the Institution through its multitude of correspondents and collectors, it would be possible to secure an immense number of valuable accessions by gift, and it is estimated that fully one-half of all the collections could be so obtained merely by paying the cost of transportation.

It is unnecessary to advance them any reasons why this bill should be passed, and the park established as proposed. We only allude to the great advantages to science and the general public which would inevitably result from the gathering together at the capital of the nation of a great collection of quadrupeds, birds, and reptiles living and breeding under highly favorable conditions. The time is fast approaching when many of our most noteworthy American quadrupeds will exist only in parks and menageries. The buffalo is now almost extinct in his wild state, and the Rocky Mountain goat is also certain to disappear in a very few years more.

Ours is almost the only great nation which does not maintain a national zoological garden on a grand scale, and we are glad to see that the idea of such an institution for us is at last taking tangible shape. It is eminently proper that it should be located at the capital city, which is now the scientific centre of the nation, and the Mecca which is visited annually by tens of thousands of citizens from every nook and corner of America.

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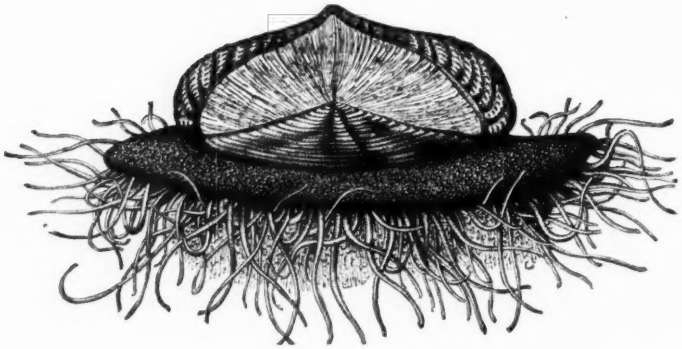
## RECENT LITERATURE.

THREE CRUISES OF THE BLAKE.[1]—In recent years American work in marine exploration has been overshadowed by the prominence given to the celebrated Voyage of the "Challenger," while the magnificent manner in which the scientific results of that voyage have been published by Her Majesty's Government is unrivalled. Still, American science is doing much to unravel the secrets of the sea, and the investigations of the Fish Commission and of the Coast Survey stand second only to those of the "Challenger" in their importance.

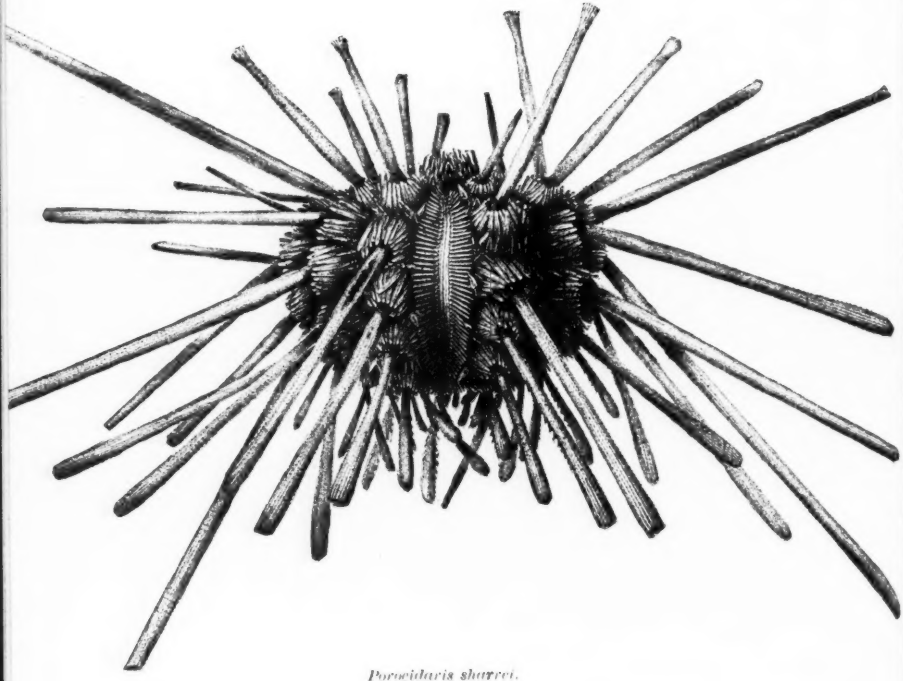
In the two volumes by Mr. Agassiz we have a popular account of the results of the Cruises of the Coast Survey Steamer "Blake," which is entitled to rank with the accounts of Moseley, Spry, or even of Wyville Thompson, of the Voyage of the "Challenger,"

[1] Three Cruises of the United States Coast and Geodetic Survey Steamer "Blake" in the Gulf of Mexico, in the Caribbean Sea and along the Atlantic Coast of the United States, from 1877 to 1880. By Alexander Agassiz. 2 vols. 8vo, pp. xxii., 314 and 220. Boston: Houghton, Mifflin & Co. 1888. $8.00.

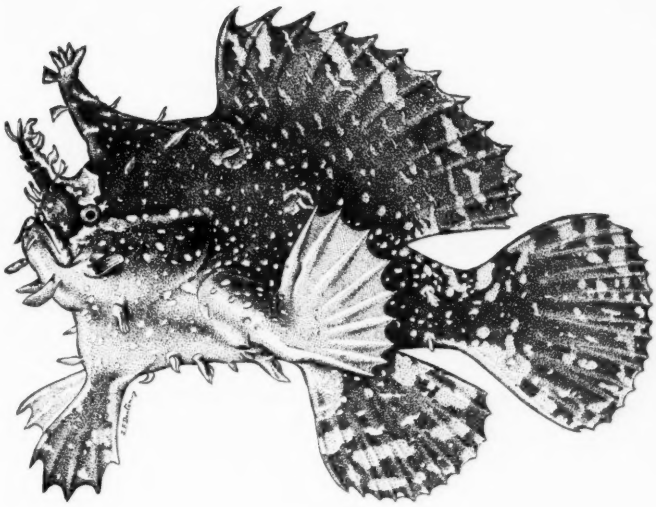
PLATE VIII.



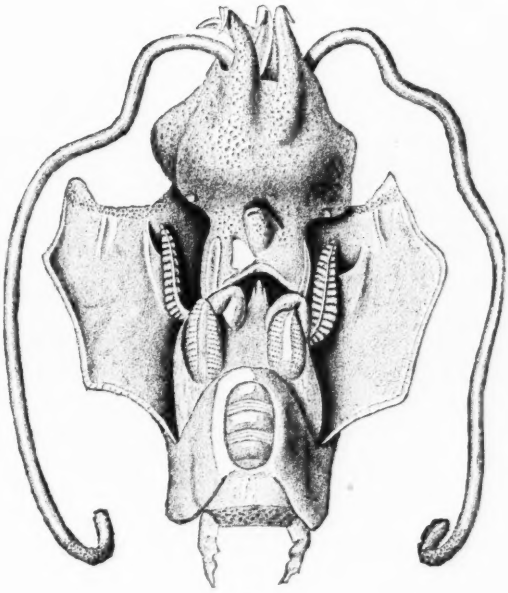
*Velella mutica.*



*Porocidaris sharreri.*



Antennarius.



Spirula.

while in wealth of illustration, in mechanical execution or in novelty of facts and theory, it stands second to none of these. Aside from the numerous maps, the illustrations have been mostly made by some of the photo-engraving processes, and the perfection to which these have arrived may be seen from the figures which accompany this notice.

Passing by the chapters which give a history of the progress of deep-sea investigation and that detailing the special equipment of the "Blake," a small three-hundred ton steamer—for the work, we come to one which has a special fascination, since it deals with the structure of the Florida reefs and their bearings on the theories of coral reefs in general. Space will not allow a recapitulation of the structure of Florida and the Florida plateau, but the facts are such as to lead Dr. Agassiz to lean towards the theory of Semper rather than to that of Darwin and Dana in seeking their explanation.

Other chapters which have a bearing upon geology and physical geography are those upon the topography of the Eastern Coast of the North American continent; the permanence of continents and of oceanic basins; the temperature of the sea in the regions explored, not only at the surface, but at the bottom as well; and an account of the Gulf Stream. All of these are illustrated by charts and diagrams, some in color, and especially interesting among the maps are reproductions of some old ones in which the Gulf Stream is shown. Somewhat similar in character is the chapter dealing with sub-marine deposits, and especially those of the deep-sea where the sources of supply are so small that even the dust of shooting stars and meteorites form an appreciable element.

The chapter on the pelagic fauna is full of interest to anyone who has seen the prizes taken by the skimming net; but to most people the second volume, which deals exclusively with the animals of the deep-sea, will prove of greatest interest. Here the author has had the aid of specialists, and has brought together a compendious account of the strange and bizarre creatures inhabiting those depths. As some of the work has been in type for two years we miss, at times, references to late discussions of certain forms. Ipnops, for instance, that curious fish without eyes, but with peculiar sensory or phosphorescent organs occupying the whole upper surface of the head, is figured, but no reference is made to Moseley's recent investigation of its structure.

As a whole, the book is full of interest, not only to the naturalist, but to those who merely desire to keep posted on the latest discoveries and explorations. Typographical and other errors are extremely few, but one of the features which seems peculiar is the retention of the antiquated names Acalephs and Polyps.

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*Woodward, A. S.*—On some remains of Siluroid Fishes from British Eocene formations. Ext. Geol. Mag. Vol. IV. No. 7. July, 1387. From the author.

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*Riefstahl, E.*—Die Sepienschale und ihre Beziehungen zu den Belemniten.

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# GENERAL NOTES.

## GEOGRAPHY AND TRAVEL.[1]

AMERICA.—THE INTERIOR OF LABRADOR.—Mr. R. F. Holme recently read to the Royal Geographical Society an interesting account of a journey to the interior of Labrador. Although the coast is utterly bare and treeless, a luxurious forest growth commences at a distance inland of about twelve miles, and clothes the whole of the country except the barrens or moors, which are the home of the caribou. Mr. Holme has ascended all the rivers that flow into Hamilton Inlet as far as navigable in a boat. One of the most important of these is the Kenamou, used as one of the routes from the south. By far the largest river of this district is the Grand, which is the name given to the channel connecting Lake Petchikapou with Goose Bay, at the head of Hamilton Inlet. Grand River is really only a portion of a continuous water-way of rivers and lakes connecting Goose Bay with Ungava Bay. Lake Wiminikapou is situated about 150 miles from the mouth of Grand River, and thirty miles above that long and narrow lake are the Grand Falls, the height of which is not known, but which may prove to be among the most stupendous in the world. The elevation of the Labrador table-land is given by Professor Hind at 2240 feet, and at least 2000 feet of this are in the thirty miles between the head of these falls and the lake below.

Lake Petchikapou, one of the largest of the interior lakes of Eastern Labrador, is connected with the ocean not only by Grand River, but by Nascopee River and Grand Lake. The Indians of the interior of Labrador are all of the Cree nation, and are perhaps the most unadulterated Indians to be found on the continent. A. G. Guillemard, in a note to the May number of the Proc. Roy. Geog. Soc. suggests that possibly the Grand Falls of Grand River (Labrador) might be reached more readily by following up the Moisie River from the Gulf of St. Lawrence and skirting Lake Aswanipi. He also says: "The fall from a height at all approaching 2000 feet of a river 500 yards in width a short distance higher up, would form one of the wonders of the world, and would surely have been described by Mr. Maclean after returning from his visit in 1839. Mr. Guillemard mentions among waterfalls combining great volume of water and great height, the Garsoppa Falls in Western Hindostan, 300 yards wide and 830 feet high, and the Kaieteur Fall of the Potaro River in British Guiana, 123 yards wide and 741 feet in vertical height.

[1] Edited by W. N. Lockington, Philadelphia, Pa.

RAINFALL WEST OF THE MISSISSIPPI.—General A. W. Greely recently gave to the Washington Philosophical Society the partial results of the charting of recent observations on the rainfall west of the Mississippi. The number of observing stations has been doubled during the past ten years, and the result of the observations has been to greatly reduce the areas of small rainfall. The area in which less than fifteen inches per annum was supposed to fall has been diminished one quarter of a million of square miles since the census map of 1880. In some places where the precipitation was supposed to be five inches or less the actual rainfall is as much as sixteen inches and in one spot was found to be thirty-seven inches. General Greely explained that the small average of rainfall formerly reported in Southern California, was partly due to the fact that most of the observing stations were situated on the line of the Pacific Railroad which, seeking low gradients, had been built through a section of the country where the precipitation was small. General Greely, moreover, thinks that the prevalent opinion that the rainfall in the West is increasing, is correct.

ASIA.—THE PROVINCES OF KARS AND SEMIRECHINSK.—According to a report upon the province of Kars (until the last Turco-Russian war a portion of Asiatic Turkey) drawn up by Prince Masalsky, the Russian immigrants into that province are not in a prosperous condition. The motley population consists besides Russians, of Turks, Armenians, Yezidis, Kurds, Greeks, Turcomans and Circassians. The province of Semirechinsk (Turkistan) had a population of 758,258 in 1885. Of these 595,000 were Kirghis, the original inhabitants. Russian colonization is continually going on, but only the central portion of the district of Vernie is yet really Russian. Large numbers of Dungans and Taranchis have recently settled in this district.

THE MOGOK RUBY MINES, BURMA.—One of the finest sanitariums in India is that of Bernard-Myo, on the broad rolling plains of Enjouk, on the northern slopes of the hills bounding the ruby mining district of Mogok, Burma. Bernard-Myo is over 6000 feet above sea level. The ruby mining district may have a population of over 6000 people belonging to many different tribes. The mines are of three kinds: the working of fissure veins; washing in a somewhat similar manner to the hydraulic mining in California; and what may be called placer diggings. The third class of mines is at present the most important. At depths varying from ten to thirty feet, in the flatter lands of the valleys, there occurs a layer of corundum from a few inches to a few feet in thickness. When this corundum is brought to the surface myriads of small rubies glitter in the sun. Almost all the stones are water worn or of irregular shapes, and it is rarely that a flawless ruby is found. So rare is a ruby of the finest water that one of three carats is worth ten times

the value of a diamond the same size. The district of Mogok is situated between Mandalay and Bhamo and is nearer to the former place.

THE BIRDS' NEST ISLANDS.—The records of the Geological Survey of India (vol. xxi. pt. 1) have some information concerning the remarkable group of islands called by the Burman's Ye-ei-gnet thaik or Seabirds' Nests. These islands consist of six marble rocks to the southeast of Dumel Island at the southern extremity of Burma. The largest is a thousand feet high, about a mile in length, and of an oval shape. The great feature of the group are the birds nests caverns, which as a rule open into the sea. In other parts of the island are great caverns opening into circular basins, and Commander A. Carpenter, who writes the account, states his impression that these circular basins were at one time the floors of huge caverns, and that in past times the islands were far higher, with cavern over cavern.

AFRICA.—THE TRANSVAAL.—The configuration of the Transvaal Republic, according to Dr. A. Schank, is determined by mountain ranges; the Drakensberg range rises to a height of 7000 feet and traverses the country from North to South, presenting a steep declivity on the East and a gradually sloping table land on the West. The Eastern and smaller part of the Transvaal consists mainly of a series of low granite mountains. A series of parallel chains extend east and west through the country and divide it into a southern portion (the Hooge Veld) and a less elevated northern portion (the Bosch Veld). The former is connected with the plateau of the Drakensberg and enjoys one of the healthiest climates in the world.

VAN GÈLE'S ASCENT OF THE MOBANGI.—The "Mouvement Géographique" of April 22, 1888, contains details of Lieutenant Van Gèle's recent ascent of the Mobangi. Van Gèle left Equator Station Oct. 27th, 1887, and on Nov. 21st reached the foot of the Zongo rapids, the spot at which the Rev. G. Grenfell was turned back in 1884. These rapids extend over a distance of twenty-four miles, and are six in number, but the steamer *En Avant* succeeded in passing them, though she had to be unloaded before she could pass the fifth, which consists of a group of islands connected together and with both banks by a rocky bar forming rapids and two falls. The banks of the river on both sides along the line of the rapids are bordered with gently sloping hills, studded with villages and presenting alternations of woods, meadows, maize fields and banana plantations. The villages on the river bank are palisaded in front and watch-posts are established in the cotton-trees. As far as Belly, in the middle of the cataracts the natives have their heads shaved except at the nape and wear fierce-looking moustaches. Above

Belly the Bakombe form the population and are distinguished from their neighbors by their method of wearing the hair, which extends behind in queues sometimes seven feet long. After passing the sixth rapid, at Mukuangai, the river comes from the northeast free from all obstacles and the view is described as superb. It has a width of about half a mile and an average depth of fourteen feet. After about twenty-two miles it bends eastward and continues in this direction as far as was navigated by Van Gèle (above 172 miles). Along this stretch the natives call it the Dua. The people on the right bank of this portion belong to the Buraka and Maduru tribes, those on the left to the Bakangi, Mombati, and Banzy. They shave the head so as to leave a little triangle of hair on the forehead, and wear immense copper rings or wooden cylinders in their ears. The native huts are cone-shaped, rest on a wall of stone about 2 feet high, and are neatly arranged in rows forming broad streets around a central building used as a common meeting place. These people work iron into all sorts of implements, weapons and ornaments. In this reach of river there are many islands, most of them inhabited and cultivated. A rapid was passed at about 130 miles above the Zongo rapids and twenty-five miles further east another was met with at which the steamer had to be unloaded. About twelve miles above this rapid (21° 30′ E. lon.) the Bangasso discharges into the right bank of the Mobangi. Up to this point the natives had invariably been friendly, offering for sale all kinds of provisions, but here difficulties began. The Mombongo and Takoma tribes which inhabit both banks were decidedly hostile, so, as the navigation was obstructed by rocks and sandbanks, Van Gèle decided to turn back at 21° 55′ east longitude. At this point the river is a mile and a half wide and is studded with islands, the larger of which are inhabited. As Dr. Junker coming westward reached 22° 55′ on the Welle, and as both points are in 4° 20′ N. lat., there can be little doubt of the identity of the Welle and Mobangi.

Geographical News.—Another voyage made by Dr. Schrader up the Empress Augusta River (New Guinea) confirms his previous opinion as to the important character of this waterway, which probably rises within the Dutch portion of the island, since the *Samoa* reached a spot distant but a few miles from the boundary line, and 380 miles from the mouth of the river. Not only the main river, but several of its affluents, are navigable for long distances during the rainy season.

M. Gamak, a Russian traveler, has recently explored the Khingan range, which divides Mongolia from Manchuria. He has crossed the range four times and has explored almost its whole length.

M. Kostenko gives the population of Russian Turkistan at 2,365,648, and that of non-Russian Turkistan at 3,042,000. Of

the latter 2,000,000 are in the Khanate of Bokhara, the remainder in Khiva and Afghan Turkistan.

The Proceedings of the Royal Geog. Soc., May 1888, contains a map of Mr. F. C. Selous' explorations in the Matabele and Mashuna countries, giving the routes of the various rivers and the position of the hill ranges with greater accuracy than any other previous map.

The death is announced of the celebrated Russian, Nicholas von Miklucho-Maclay, whose name has so long been prominent in connection with explorations in New Guinea. His residence in that country impaired his health, and in 1882 he returned to Russia. After this he resided awhile in Sydney (Australia) where he founded a biological station, and then again returned to Russia, where he resided at the time of his death, at the age of forty-two years.

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## GEOLOGY AND PALÆONTOLOGY.

Geological News.—Silurian, etc.—Dr. John Walther, in his researches into the structure of the crinoids (Palæontographica, Band 32), traces the entire group to a bilateral ancestral form, represented by the Pelmatozoa of the Pre-Cambrian, and considers the Ateleocystites of the Lower Silurian as a reversion to this ancestral and larval form. This is followed by an "acyclical" holosymmetrical form, exemplified by Macrocystella, the oldest Cambrian Pelmatozoan. From this form two series arise—on one hand, the Cystoids, on the other, the Crinoidea.

Devonian.—M. Maurice Gordon has discovered in the Valley of l'Arboust, in the Pyrenees, a schistose deposit with trilobites which are entirely new to the French fauna and ascend to an epoch that has recently been studied between the Hartz and the Ural. These trilobites include two new species of Bronteus and one each of Dalmanites, Lichas, Cyphaspis, and Harpes. M. Chas. Barrois states that the fauna is more recent than the Silurian stage of Bohemia and older than the Coblencian stage of the Devonian.

M. Chas. Barrois has identified twenty-eight species of crinoids, brachiopods, trilobites, etc., occurring in the singular sedimentary limestone of the quarry of Vallet, near Chaudefonds (France). Though this thin bed is certainly Devonian, it has not yet been correlated with the other Devonian bands of the region, but seems to form an islet in the midst of red and green schists, which are by some referred to the Lower Silurian, by others to the Upper Devonian, or even to the Carboniferous. The trilobites are Silurian, but the brachiopods and crinoids are Devonian, and the fossils, as a

whole, are referred by M. Barrois to the same horizon with the Eifelian beds of the Rhine.

The coral limestone of Cabrieres (Herault, France) is by M. Barrois ranged between the Eifelian and the Coblencian stages of the Devonian.

CARBONIFEROUS.—*Spirodomus insignis*, is a peculiar, spirally-twisted lamellibranch, recently described by Chas. E. Beecher, from the attenuated Waverly series of northwestern Pennsylvania. In its reflexed and minutely plicated margins and absence of proper hinge, this shell suggests some forms of Pholas, and its spiral form seems to indicate a burrowing habit.

Among the impressions of fishes collected in the shales of the coal-beds of Commentry are some with a cartilaginous skeleton ossified at certain points and presenting peculiarities not to be found in any other living or extinct fish. The study of twenty-three examples of this fish, some of them in a good state of preservation, has enabled M. Brongniart to describe it under the name of *Pleuracanthus gaudryi*. In form this fish resembles a shark, and in length it varies from eighteen to forty inches.

JURASSIC.—Dr. E. Fraas (Palæontographica, Band 32) treats of the asteriads of the White Jura of Swabia and Franconia, with researches into the structure of echinoderms and the skeleton of the Asteroidea. He describes as new *Astropecten infirmum* and *A. elegans;* also *Pentacerus pustuliferus*, from the lithographic schists of Kelheim.

E. Koken (Palæont. Abhandl., 1887) has contributed additional information upon the Dinosauria, Crocodilia, and Sauropterygia of the Wealden of Northern Germany. Among the crocodiles, *Goniophotis pugnax* and *G. minor*, and among the Sauropterygia, *Plesiosaurus degenhardti*, *Pl. limnophilus*, and a third unnamed Plesiosaurus, are new. The work also contains much information upon the development of the brain and auditory passages of the genus Macrorhynchus.

CRETACEOUS.—*Gigantichthys pharao* is the name given to a fossil fish of the family Trichiuridæ, collected by Professor Schweinfurth in the cretaceous beds of Egypt, within ten kilometres of the Pyramids of Gizeh.

CÆNOZOIC.—Dr. O. Roger concludes (Ueber *Dinotherium bavaricum*, Palæontographica, Band 32) that *D. bavaricum* is the smaller, older ancestral form, contemporary with Anchitherium, out of which, by a series of transitional forms, the gigantic *Din. giganteum* was finally developed in the Hipparion period.

In 1885 Professor M. Neumayr and Dr. L. v. Tausch undertook explorations in the Pliocene beds of Pikermi, near Athens, for the

benefit of the Vienna Museum, and the result of their work has been to considerably widen our knowledge of that rich fauna. Dr. A. Weithofer describes as new *Mustela palæattica, Machairodus schlosseri, Camelopardalis parva, Helicoceras rotundicorne,* and *Varanus marathonensis,* and mentions some avian remains of as yet undetermined forms, two of which seem to belong to the genus Gallus. A species of Felis, mentioned but not described by Gaudry in 1862 as at least equal in size to the largest jaguar, is by Dr. Weithofer described as *F. leiodon. Helicoceras rotundicorne* is a gazelle-like antelope with rather large and spiral horns.

A. S. Woodward (*Geol. Mag.,* July, 1887) describes *Arius egertoni* and *A.* (?) *bartonensis,* two forms of siluroids from the Middle and Upper Eocene beds of Bracklesham and Barton (England).

Van Beneden (*Zeitschr. deutsch. geol., Ges.* 1887) has described Cetacean remains from the northern slopes of the Caucasus. These remains probably belong to the genera Squalodon and Cetotherium. The age is Upper Miocene.

PLEISTOCENE.—The exploration of the caves in the Karnul district of Madras, conducted by Mr. R. B. Foote, has resulted in the finding of about forty species of Mammalia, of which Mr. R. Lydekker (Mem. Geol. Surv., India, Ser. X., Vol. IV., Pt. 2) describes as new *Viverra karnuliensis, Hystrix crassidens, Atherura karnuliensis, Rhinoceros karnuliensis,* and *Sus karnuliensis.* The most important of the Karnul caves are those of Billa Surgam, which consist of three short and deep cañons joined by natural arches, and with caves opening into them at various levels. The comparatively large number of extinct forms and forms not now to be found in India that occur in these deposits renders it probable that they are not newer than the Pleistocene, and Mr. Lydekker refers them to the later part of the Narbada period. The most remarkable features of the list are the occurrence of a Cynocephalus which may be identical with a living African species; of *Hyæna crocuta;* of a small Equus indistinguishable from *E. asinus,* and of a Manis, apparently identical with the existing West African *M. gigantea;* while the occurrence of a peculiar species of Rhinoceros and of a Hystrix and a Viverra specifically distinct from those now living in India, as well as of the non-Indian genus Atherura, is scarcely less noteworthy. The evidence afforded by this cave-fauna strengthens that afforded by the Siwaliks as to the probable derivation of many of the existing Ethiopian mammals from those of the later tertiaries of India.

Drs. L. Doderlein and E. Schumacher describe, in a bulletin of the Geological Survey of Alsace-Lorraine, a rich diluvial mammalian fauna that has been recently found at Voklinshofen, near Colmar. Twenty-nine forms are listed, most of them large and mostly extinct in Alsace, though many occur in northern Europe or in the Alps.

## MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—In a preliminary notice of the rocks occurring in the neighborhood of Ilchester, Howard county, Md., Mr. Hobbs[2] describes some interesting features of the eruptive masses of the region. The oldest rock within the area studied is a hypersthene-gabbro with its associated alteration products.[3] In the gabbro diorite, originating by dynamic metamorphism from the massive hypersthene-gabbro, ilmenite and rutile are found to be so associated with sphene as to lead the author to regard the rutile as an intermediate product in the alteration of ilmenite to sphene. The end product in the alteration of the gabbro is a typical hornblende-gneiss, in which peripheral granulation of the original feldspar can be detected. A quartz-mica-diorite, in which the quartz is in porphyritic crystals, contains about equal proportions of orthoclase and plagioclase. The most common form of granite, cutting the gabbros and allied rocks, is a coarse pegmatite in which microcline crystals a foot in diameter are sometimes observed. A less common form of granite is a gneissic granite-porphyry, most interesting on account of the occurrence in it of the rare mineral allanite,[4] in parallel intergrowths with epidote.—The diabase pitchstone of Sordaval, in Finland, was for a long time regarded as a mineral, to which the name sordawalite was given. This substance has lately been very carefully studied by Lœwinson-Lessing,[5] who finds it occurring as a dyke, cutting amphibole-schists. In the centre of the dyke the material is highly crystalline; at its edges it is very vitreous. Several types of the vitreous variety are characterized, as hyaline, globulitic, spherulitic and microlitic. The first-mentioned variety gives rise by alteration to several sub-varieties, among which may be mentioned the granellitic and radiolitic varieties. The former consists of a glassy type, in which certain dark particles group themselves so as to produce patches of a dark color on a background of light-colored glass, without the production of a true globulitic or spherulitic structure. In the radiolitic variety devitrification products are divergently arranged around a centre.—The nodules of the coarse granite at Ghistorrai, Sardinia, are described by Fouqué[6] as composed of a centre of orthoclase, oligoclase, biotite and muscovite, around which is a zone consisting of triclinic soda-feldspar and biotite, arranged in concentric layers. The biotite of the nodule is older than the feldspar and remains quite fresh, while the same mineral in the body of the rock is much altered.

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Johns Hopkins Univ. Circ., No. 65, April, 1888, p. 68.
[3] Cf. Amer. Naturalist, 1886, p. 1049.
[4] Cf. Amer. Naturalist.
[5] Min. u. Petrog. Mitth., 1887, ix., p. 61.
[6] Bull. d. l. Soc. Franç d. Min., x., p. 57.

NEW MINERALS.—*Caracolite* from Caracoles, Chili, has lately been described by Sandberger[1] as a new mineral. It is intimately associated with percylite, and like this latter is regarded as derived from galena by alteration. Caracolite occurs in transparent crystals with a hexagonal habit; produced by trillings of rhombic individuals according to the aragonite law. The axial ratio is: $a : b : c = .5843 : 1 : .4213$. Its specific gravity is 5.1. Its analysis yielded results corresponding to the formula $Pb(OH)Cl + Na_2SO_4$. The associated *percylite* was also analyzed and found to correspond to $Pb(OH)Cl + Cu(OH)Cl$.—*Mursinskite*[2] has been found only in two small yellow translucent crystals at the topaz locality at Mursinsk, near Alabaschka, in the province of Ekaterinoslaw, Russia. The crystals are tetragonal with an axial ratio, $a : c = 1 : 0.5664$. They are bounded by P, $2P\infty$, $\frac{5}{3}P\infty$, and various ditetragonal pyramids. Their composition is unknown. —*Bementite* is a radially fibrous mineral not unlike pyrophyllite in appearance, which occurs at Franklin, N. J. Its color is gravish yellow, and its specific gravity 2.981. Its composition as described by Prof. König[3] is:—

| $SiO_2$ | Mn O | Fe O | Zn O | Mg O | $H_2O$ |
|---|---|---|---|---|---|
| 39.00 | 42.12 | 3.75 | 2.86 | 3.83 | 8.44. |

corresponding very nearly to $(H_2, Mn)_2 Si O_4$.—*Martinite* is a new calcium phosphate from the Island Curaçoa, in the West Indies. It occurs, according to Kloos,[4] only in pseudomorphs after gypsum. Under the microscope it is seen to consist of an aggregate of little rhombohedra. Its specific gravity is 2.892 to 2.896. Its analysis yielded:—

| $P_2O_5$ | Ca O | $H_2O$ | Org. subs. | Insol. |
|---|---|---|---|---|
| 47.77 | 47.20 | 4.52 | .75 | .20 |

—*Arseniopleite* is a reddish brown substance associated with rhodonite and hausmannite in veins in a crystalline limestone at the Sjö mine, Gryhyttan, Province of Oerebro, Sweden. Its analysis yielded Igelström[5]:—

| $As_2O_5$ | Mn O | $Fe_2O_3$ | Pb O | Ca O | Mg O | $H_2O$ |
|---|---|---|---|---|---|---|
| 44.98 | 28.25 | 3.68 | 4.48 | 8.11 | 3.10 | 5.67 |

—*Barysilite*[6] is a lead silicate ($3PbO.2SiO_2$) from the Harstig iron mine at Pajsberg, Sweden. Its color is white, crystallization hexagonal, hardness about 3, and its specific gravity 6.11 to 6.55.—*Calciothorite*, *Melanocerite* and *Rosenbuschite* are silicates of the rare

[1] Neues Jahrb. f. Min., etc., 1887, ii., p. 75, and Websky: Sitzb. Ak. Wissensch Berlin, Nov., 1886.
[2] Kokscharow: Bull. d. l'Acad. Imp. des Sciences d. St. Petersb., 1887, p. 450.
[3] Proc. Acad. Nat. Sc. Phila., Oct., 1887, p. 311.
[4] Sammlg. d. Geol. Reichsmus. Leiden. Ser. ii., Bd. i. Ref. Neues Jahrb. f. Min., etc., 1888, i., p. 41.
[5] Bull. Soc. Min., 1888, xi., p. 39.
[6] Sjögren and Lundström: Oefv. Vet. Ak. Förh., 1888, xlv., p. 7.

metals. They are found in the elæolite-syenite veins of Norway.[1] —*Cliftonite.* With reference to certain little cubical crystals of graphite (?) found in pieces of an iron meteorite from Youndequi, Australia, Fletcher[2] states that Haidinger as early as 1846 described crystals of graphite, which he regarded as pseudomorphs after pyrite. Since pyrite does not occur in meteorites, and since, moreover, these little graphite pieces are entirely surrounded by metallic iron, Fletcher thinks that their shape must be original, and that this substance is truly regular in crystallization.

Crystallographic News.—It has been known for a long time past that the natural conclusions to be drawn from the Bravais-Mallard theory of cleavage planes and crystal structure, based upon the point system of explaining crystallization, have not been borne out by the facts. As a consequence of this theory it is demanded that the planes of easiest cleavage in a mineral should be parallel to those planes which are most commonly present on it and best developed. This is known, however, not to be the case. Sohncke[3] explains how these difficulties can be met by modifying the theory of the point system, as pointed out by him in recent[4] papers.—The same subject is further discussed by Wulff,[5] who takes up the different crystallographic systems in detail, describes in terms of the theory the inner structure of minerals crystallizing in each, and pictures the development of holohedral, hemihedral and hemimorphic forms. Three lithographic tables, with one hundred figures, illustrate the paper.—Brugnatelli[6] has subjected the *elatholite* occurring in the contact between serpentine and gabbro at the Serra dei Zanchetti, in the Bolognese Appenines in Italy, to a complete examination, both crystallographic and optical. He finds forty-one forms on the crystals examined, among them the new forms $\frac{4}{3}\,P\overline{\infty}$, $2\,P\bar{2}$,–5 $P_5$,–$\frac{3}{2}$ $P\bar{3}$–,–$\frac{5}{2}$ $P\,\bar{5}$ and3 $P\frac{\bar{3}}{2}$ ($a : b : c = 1.2657 : 1 : .6354$ $\beta = 89°\ 51'$). The optical angled measured in oil is 74° 21′ for sodium light, and the first bisectrix is inclined 51′ to the $c$ axis, in the acute angle $\beta$. An analysis of the mineral gave $Si\,O_2 = 37.89$, $Ca\,O = 35.04$, $B_2\,O_3 = 21.23$, $H_2\,O = 5.84$.—*Cinnabar* crystals from Mt. Avala, near Belgrade in Servia, have been carefully measured by A. Schmidt.[7] He finds on them trapezohedral forms so largely developed as to determine their habit. To the forty-eight forms already described as occurring on the mineral, Schmidt adds ten new ones, viz.: $\frac{1}{2}$ P2, $\frac{2}{3}$ P2, $\frac{6}{13}$ $P\frac{6}{5}$, $\frac{2}{5}$ $P\frac{4}{3}$, 2 $P\frac{4}{3}$, 2 $P\frac{5}{4}$, $\frac{3}{7}$ $P\frac{3}{2}$, $\frac{8}{5}$ $P\frac{8}{5}$, $\frac{10}{23}$ $P\frac{5}{3}$ and $\frac{5}{6}$ $P\frac{5}{3}$.—The negative deltoid dodecahedron–$\frac{3\,O}{2}$

[1] Brögger: Geol. Fören. Föhr., 1887, ix., p. 247.
[2] Miner. Magazine, July, 1887; and Zeits. f. Kryst., xiii., 1887, p. 383.
[3] Zeitsc. f. Kryst., xiii., 1887, p. 209.
[4] Wiedem. Annalen, 1882, 16, p. 499.
[5] Zeits. f. Kryst., xiii., 1888, p. 503.
[6] Zeits. f. Kryst., xiii., 1887, p. 150.
[7] Zeits. f. Kryst., xiii., 1888, p. 433.

has been detected by Hintze[1] on a crystal of sphalerite from Striegau.

MISCELLANEOUS.—As the result of a series of experiments upon the strongly pleochroic epidote of Sulzbachthal, Ramsay[2] finds that the absorption colors of this mineral are not symmetrically arranged around the axes of elasticity *vi* and *c* lying in the plane of symmetry. Moreover, he finds that the absorption axes—the directions in which the greatest, the least and the mean absorption takes place—do not correspond with the axes of greatest, least and mean elasticity, as had already been indicated by earlier observations. The direction of greatest absorption for the red ray in the clinopinacoid is inclined 28° to the axis of least elasticity, while the direction of absorption of the green ray is inclined 35°. After examining a large number of thin plates prepared from epidote and other monoclinic minerals, and one triclinic mineral, Ramsay concludes (1) that one of the absorption axes in monoclinic crystals coincides with the axis of symmetry *b*, while the other two lying in the plane of symmetry do not necessarily coincide with the axes of elasticity for the same color. In triclinic minerals there is no accordance between the absorption axes and the axes of elasticity. (2) The axes of greatest and of least absorption for any given color in triclinic minerals and the absorption axes lying in the plane of symmetry of monoclinic minerals are not always perpendicular to each other, as are the axes of elasticity.—The same subject is discussed mathematically by Drude,[3] who calculates the positions of absorption maxima in monoclinic and triclinic minerals from data obtained by Ramsay. He finds slight discordances between the observations of Ramsay and the theoretical demands, but concludes that, on the whole, Voight's[4] theory of absorption is substantiated.—By supplying a blast lamp with warm air and with oxygen, Specia[5] has succeeded in fusing many of the minerals infusible under ordinary conditions. The differences in their conduct under these changed conditions may serve to distinguish between minerals having the same general appearance; *e.g.*, quartz is infusible even when the blast lamp is supplied with warm air, while it is easily fusible to a colorless glass when oxygen is used. Colorless topaz is difficultly fusible in the first case, while it fuses readily with intumescence in the second case. Colorless zircon is infusible in both cases, but becomes cloudy at the high temperature produced by the combustion with oxygen.

[1] Zeits. f. Kryst., xiii., 1887, p. 161.
[2] Zeits. f. Krystallographie, 1887, xiii., p. 98.
[3] Zeits. f. Krystallographie, 1888, xiii., p. 567.
[4] Wiedem. Annalen., 1884, 23, p. 577.
[5] Atti. d. R. Accad. d. Scienze di Torino, xxii., p. 1887. Ref. N. J. B., 1888, i., p. 177.

## BOTANY.[1]

AN OVERLOOKED FUNCTION OF MANY FRUITS.—It is a matter of common observation that many fruits (carpels) are green in color for a considerable period after the fertilization of the ovules, but I am not aware that particular attention has been called to the significance of this fact. Different botanical authors mention, incidentally as it were, the fact that as long as the young fruits are green they, of course, perform the functions of leaves, by the fixation of carbon in the process of assimilation. All such statements, however, take no account of the fact that young fruits, for the most part, are not green at first, but become so during their increase in size; in other words, the *greening* of the young fruit has been overlooked as having any significance. It has apparently been assumed that young fruits must turn green as a matter of course.

I wish to suggest that the very general development of chlorophyll-bearing tissue is for the nutrition of the embryo in the seed. The White Elm (*Ulmus americana* L.) affords a good illustration of this function of the fruit. At the time of flowering there are no leaves upon the tree, nor do any appear until the fruits are full grown, yet within a few days after the fertilization of the ovules, the growing fruits cover the tree with a green coat resembling that afforded by the leaves themselves a few weeks later. The first assimilation by this tree in the spring is done by the chlorophyll-bearing tissue of the young fruits. The same holds true for the Red Elm (*Ulmus fulva* Mich.).

The Box Elder (*Negundo aceroides* Moench) develops its fruits much later, but they take on likewise a rich green color, and in the latter part of May in some instances add fully fifty per cent. to the assimilating surface of the tree. Maples, Ashes, and even Poplars and Willows, the latter to a less degree, present the same phenomena, and in fact, in by far the greater number of instances the greening of the fruit for aid in the work of assimilation is the rule.

In the Pines and their allies the development of chlorophyll-bearing tissue is confined to the scales of the cone. In the biennial species there is but little green tissue the first year, when the ovule is dormant, but with the beginning of those rapid changes which occur in the spring of the second year, the scales become enlarged into great masses of parenchyma richly provided with chlorophyll. So marked is this that I have often wondered whether the scale was not primarily developed as an organ of nutrition. I have thought, sometimes, that possibly the scale was but a kind of dorsal growth of the ovule, in order to provide itself with an assimilating tissue. —*Charles E. Bessey.*

[1] **Edited by Prof. Chas. E. Bessey, Lincoln, Neb.**

A DEPAUPERATE GRASS.—The accompanying illustrations (Figs. 1 and 2) show a depauperate individual of *Sporobolus vaginæflorus*, found entangled in the roots of a *Solidago* which was collected on the high prairie a few miles southwest of Lincoln. This little grass had three flowers, two of which had ripened seeds. The lower one of the three was still included in the upper leaf sheath.

FIG. 1.—Plant of *Sporobolus vaginæflorus* Torr., natural size.

FIG. 2.—A spikelet dissected, magnified ten diameters.

The sod from which the specimen was taken was formed of *Stipa spartea*, *Andropogon provincialis*, *A. scoparius* and *Bouteloua racemosa*, and a close observer would find no trace of the Sporobolus. In fact, *S. vaginæflorus* does not appear on the uplands except where the ground has been broken by natural or artificial agencies. The presence of this single specimen clinging to the roots of a high prairie denizen is of great significance in explaining its apparently sudden appearance on gopher mounds and along cultivated fields.

The existence of depauperate plants stowed away down out of sight, struggling hard with the powerful and strong for a scanty subsistence, waiting for better conditions and better times, doubtless bears a more important relation than has been thought to the sudden appearance of strange plants.—*Jared G. Smith, Lincoln, Neb.*

BOTANICAL NEWS.—The "Preliminary Catalogue of Anthophyta and Pteridophyta reported as growing spontaneously within one hundred miles of New York City," compiled by a committee of the Torrey Botanical Club, is a valuable addition to catalogue literature. It is important also on account of the adoption by the club of the term Anthophyta for the Flowering plants.—The Proceedings of the Forestry Convention, held in Grand Rapids, Michigan, January 26 and 27, 1888, has been published in a pamphlet of sixty pages, and contains along with much indifferent matter some which has value.—In marked contrast with the foregoing in the treatment of the subject are the "Lectures on Forests and Forest Products," given by Dr. G. L. Goodale before the Lowell Institute, in February and March of 1888. The Syllabus of the lectures shows a thoroughly scientific treatment of the subject. Perhaps the two methods of handling the subject are necessary, but for our part we greatly prefer that of the Harvard

professor.—Dr. N. L. Britton has described and figured the remains of a supposed plant from the white crystalline limestone (Archaean) of Sussex Co., New Jersey. He names it *Archæophyton newberryanum*, and gives a good plate. The paper appeared in the Annals of the New York Academy of Sciences, Vol. IV., No. 4. —The microscopical anatomy of the common cedar apple (*Gymnosporangium macropus*) has been investigated by Elmer Sanford (in the Botanical Laboratory of the University of Michigan), the results of which appeared as a paper in the February number of the *Annals of Botany*.—Dr. Farlow has added to his list of works on North American Fungi by the publication of nearly one hundred additional titles, in No. 30 of the Bulletins of Harvard University Library.—In Professor Trelease's study of the North American Geraniaceæ (Memoirs Boston Society Nat. Hist., Vol. IV.) the author has brought together descriptions of our species of the order, with biological notes, references to their pollination, dissemination, etc. Four good plates aid in giving to the monograph greater value.

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## ZOOLOGY.

North American Infusoria.—Dr. A. C. Stokes has done students of the Infusoria good service in collecting together in his "Preliminary Contribution toward a History of the Fresh-water Infusoria of the United States" (*Journal Trenton Nat. Hist. Soc.*, vol. i., pp. 71–344, pls. xiii., 1888), an extended catalogue of all the known species in the United States. Even his own papers appeared in so many places that it was rapidly becoming impossible to keep track of them all. In the present catalogue 351 species are enumerated, distributed as follows:—

| | | |
|---|---|---|
| Flagellata | | 153 |
| | Monadina | 27 |
| | Euglenoidea | 46 |
| | Heteromastigoida | 20 |
| | Isomastigoida | 24 |
| | Choano-flagellata | 30 |
| | Dino-flagellata | 3 |
| | Cilio-flagellata | 3 |
| Ciliata | | 268 |
| | Holotricha | 58 |
| | Heterotricha | 29 |
| | Peritricha | 122 |
| | Hypotricha | 59 |
| Suctoria | | 30 |

It will be noticed that Dr. Stokes accepts both the Cilio- and the Dino-flagellata, contrary to the recent classifications. His reasons

are that while there is a second flagellum in some of the Peridinidæ, in others of the old group of Cilio-flagellates there are true cilia in the equatorial grove or scattered over the surface of the body, and hence the group must be retained. It is interesting to note that while Dr. Stokes has given names to nearly 250 new species of Infusoria in his various papers, he has carefully refrained from adding to the number in the present contribution.

Two Cases of Symbiosis.—Dr. C. P. Sluiter notices two instances of "mutualismus" as occurring in the seas of Batavia. In shallow water there is found a large sea anemone (Actinia) abundant on the dead coral. It spreads a disc sometimes sixteen inches across, the disc, tentacles and body being colored of various shades of purple. Swimming in and out among the tentacles of this actinia are usually found two or more small species of fish identified as *Trachichthys tunicatus*. These seem to suffer not the least harm from the cœlenterate nettle cells, but rather to seek protection from enemies among the tentacles. In one case, Dr. Sluiter removed several fish from their protector and placed them in an aquarium with several larger fishes. The little ones tried their best to hide among the corals and the spines of the echinoderms, but soon fell victims to the appetites of their cousins. Others placed under similar conditions, but in company with anemones, survived for over half a year. They prove very timid, and rarely venture but a short distance from home. Their food is mostly the droppings from the Actinians table.

The second case, also noticed by Sluiter, occurs between Bunodes and *Trachichthys clarkii*. In this instance but a single fish has been found with each anemone, but this, as it is larger than its relative, ventures farther from home in search of food. In case a bit of food be dropped near the Bunodes, the fish darts out and, when it is about eight inches away, seizes the morsel, which may be half as large as itself, and quickly darts back to the hiding-place. Then the fish jerks the meat against the tentacles, and when these have grasped it, the fish tears it in shreds, some of which are small enough to be swallowed. In case the actinian has swallowed the morsel before the fish has had its fill, the latter darts into the stomach and brings out the matter, and proceeds to tear it to pieces as before.

Earth-Worms.—N. Kulagin communicates (*Zool. Anzeiger* xi., 231) some observations on Russian Earth-worms which are worthy of note. The cuticle, composed of H, C, O and N, is not a true chitin, but might be called a precourser of it. It dissolves readily in weak hydrochloric and other acids, and to prevent this effect by the humus acids in which the worm lives, the ectodermal glands secrete an alkaline fluid. The egg cocoons differ much, as they withstand strong acids and pepsin. The fluid of the mouth and

pharynx has an alkaline reaction, and converts starch into sugar and fibrin into peptone. The calc-glands also alter starch. The gastric juice is much like pancreatic juice, but is distinguished by the presence of tripsin, and by the fact that it apparently works better in the presence of weak acids. The cells of the typhlosole not only absorb the digestive juices, but they also have a digestive function much like that of the pancreas of the Vertebrates. Other observations relate to the histology of the epidermis, the pigment material, the œsophageal muscles and the calc glands. Some notes are made on the distribution of the Russian species, two of which occur even in the Lena Delta.

RECENT NOTES ON SCAPHIOPUS HOLBROOKII.—The general characteristics of this animal have been long and familiarly known and its more prominent anatomical features clearly defined; but its rather circumscribed distribution and comparative rarety, even where known to exist, have made somewhat difficult any extensive study of its peculiar nature and habits.

A summer on Martha's Vineyard, and the occasion of a sudden and tremendous rainfall, afforded an opportunity for certain very interesting observations.

If the literature of the subject is any indication as to its familiarity, the submission of the following notes may not seem a work of supererrogation; for, aside from the studies of Dr. Chas. C. Abbott, published in Vol. XVIII, No. 11, of the AM. NATURALIST, and those of Colonel Nicolas Pike, published in Vol. I, No. 7, of the *Bulletin of the American Museum of Natural History*, I have not been able to find anything except brief notes, scattered in miscellaneous works, though I believe notes on its occurrence have been made by Mr. Nichols and by Mr. Fred. S. Smith.

My observations, as will be seen, add but little that is *new;* yet a record of them may contribute somewhat to corroborate and extend that which does exist.

One afternoon, about August 10, 1887, while at work in the laboratory of the Martha's Vineyard Summer Institute, in company with Dr. H. W. Conn, Professor L. W. Chaney, and others, a very sudden and torrential rainstorm occurred, lasting some two hours or more. During an interval of cessation our attention was diverted by weird, plaintive sort of cries, which none at first was able to explain. Darting out through the still-falling rain toward a low sort of hollow, from which the cries seemed to come, it was found to have been converted into quite a pond, though previously quite dry. In this, and swimming about in a state of the greatest activity and excitement, were what looked to be scores of toads. No difficulty was found in securing a few specimens, which were at once identified as "spadefoots." Procuring a scoop-net, we took several dozens of them, leaving many more in the pond.

This was about four o'clock in the afternoon, and they continued

their orgies till late at night. But I made careful examination the following morning, without finding a single specimen—not even a sign of one. In the water I found plenty of the spawn attached to grass and floating in strings, loosely attached to weeds—a fact which clearly indicated the purpose of their presence and peculiar excitement.

On account of the pressure of other studies, I was not able to watch the development of the eggs. Indeed, I doubt whether they ever hatched, as the pond was nearly dry before the close of the following day, and the soil, being of the loose sandy drift peculiar to that locality, would not certainly retain water for sufficient time for the growth of the tadpole—if, indeed, for the hatching of the eggs, though, as to this last, I cannot say, as I left before it could have occurred.

This characteristic of the spawning habit is certainly peculiar, and seems somewhat difficult to explain. First, the lateness of the season is remarkable. It is said that a related European species breeds twice a year. Can it be possible that such is the case with Scaphiopus? There are some facts which seem to indicate that it might be, though it is hardly probable. Second, the places of spawning is still more remarkable. From the observations of Dr. Abbott and Colonel Pike, as well as my own, the choice seems to be for some temporary sink-hole or surface-pond. If the conditions for development in these places from speedy drainage, etc., were not so utterly precarious, it might be thought a shrewd precaution for evading the natural enemies common in the more permanent ponds and bogs. Altogether, the case seems to be quite anomalous.

But to refer again to the adults in the pond: There they were by scores. Whence had they come, and in such numbers? In all probabilities, from the ground of the bordering hillsides and environs. But not a single specimen was seen out of the water, and that, too, notwithstanding we were at the pond almost immediately following their first coming. If they had come from any tolerable distance, it would seem that some late-comers would have been detected. Again, their retreat must have been almost as sudden as their appearance. I passed the pond about ten o'clock at night, and the air was perfectly vocal with their never-to-be-forgotten notes. I went to the pond early the following morning, but all was silent and deserted. Had they returned to the ground? Such seems the most probable explanation. Yet so carefully had they covered the retreat that not the slightest trace could be found.

Furthermore, their appearance itself seems to be capricious and phenomenal. I made inquiries of persons of observant habits as to any previous occurrence in the vicinity, but was not able to find any account of them.

It has been suggested that they are, doubtless, nocturnal in habit, and that this explains, in a measure, their comparative rarity, even where known to exist. I have no hesitancy in assenting to the

nocturnal habit. It is quite in keeping with the habit of many of the order; and the vertical pupil of the eye points likewise to the same fact. This, however, in itself, must be a comparatively small factor in the case, and, alone, would hardly insure it against frequent detection any more than does a similar habit in many other nocturnal animals. I had gone by this hollow repeatedly, night after night, both before and after this appearance, and, though constantly on the alert to notice anything of the sort, had no hint of their presence.

Doubtless, the solitary burrowing habit goes much further in explaining its seclusion. But even this would be inadequate, unless the animal persistently avoided all open and cultivated grounds. Such, only, would protect it against frequent exposure by the spade or plow.

Altogether, they are certainly the most peculiar and erratic of any of the order; and, under the peculiar difficulties in the way of continuous study, it will be long ere its life-history can be said to be thoroughly known. However, the very difficulties add a charm to the investigation, which we may hope will lead to success. To me, the brief research herein outlined has been full of the liveliest interest, and, while but a mite toward the solution of the problem, I shall hope that it may not be without some value when a final summary is made.—*C. W. Hargitt, Moore's Hill, Ind.*

The Relative Weight of the Brain to the Body in Birds. — In a former number of the American Naturalist,[1] notice was made of the relative weight of the brain to the body in *Spizella socialis*, and *Regulus satrapa* compared to that of man. Since that time more extended investigation has been made, with a view of ascertaining the relative weight of the brain to the body in different species of birds, the result of which is appended below.

An interesting fact developed from these figures is that there is considerable individual variation in the weight of the body and brain in different individuals of the same species;[2] this is no doubt dependent in some way upon the time of year, the amount of food supply, and individual idiosyncracy;[3] there is no sexual distinction in regard to the relative weight of the brain to the body—but, on the contrary, male and female alike offer marked degrees of fluctuation in this regard. Exception, however, exists in the two specimens of different sexes of *Harporhynchus rufus*, which closely coincide in their relative weights.

Most of the specimens considered here were taken at Grand Crossing, Illinois, the remaining ones in Chicago. Light loads of

[1] Vol. xxi., April, 1887, p. 389.

[2] Notice especially the series of weights of *Dendroica æstiva*.

[3] Notice a specimen of *Dendroica æstiva*, taken June 4th, which weighed more in body and brain than any specimens of the same species taken before that date.

the so-called "dust" shot was used in shooting the specimens, which, as soon as they were killed, were placed in a cool place, and weighed within a few hours afterwards. It takes twelve of these dust shot, by actual count, to equal a grain weight, and advantage of this fact was taken into account in estimating the weight of the shot that passed through the skin of the specimens, and subsequently deducting this after the weights of the individual had been taken. This was obviously of little importance in the ultimate result; however, every precaution was taken to avoid errors. The weight of the brain and body are given separately, and the relative weight of the former to the latter, all the weights being designated in grains, as a matter of simplicity. In the weighing of the specimens the bird with all its parts intact was laid upon the scale-pan of a prescription scale similar to those used in apothecary stores, which weigh accurately to half of a grain. After being weighed and noted, the brain of the specimen was carefully removed[1] by making a circular incision, and the removal of the piece of bone, thereby cut free, from the posterior part of the cranium by means of a small scalpel. The opening that remains after the operation being sufficiently large to admit of the withdrawal of the entire encephalon after the optic nerves have been severed and the spinal cord likewise treated below the medulla oblongata. After the brain was removed in this way it was weighed upon a more delicate saddle-back scale, which weighed accurately as low as the tenth of a grain. Forty-seven birds were thus weighed, and for purpose of comparison with some small mammals four adult specimens of the common house mouse, *Mus musculus*, and one specimen of the common gopher, *Spermophilus tredecimlineatus*, are reckoned.

| Name of Specimen. | Weight of Body. | Weight of Brain. | Sex. | Relative wt. of Brain to the Body. | Date specimen was taken, 1887 |
|---|---|---|---|---|---|
| Turdus aliciæ | 589½ | 12 | ♀ | 1-49 | May 20th |
| Turdus ustulatus swainsonii | 445 | 12½ | ♀ | 1-36 | " |
| Turdus aonalaschkæ pallasii | 430 | 12¼ | ..... | 1-34 | April 15th |
| " " " | 420 | 13½ | ..... | 1-31 | " |
| Galeoscoptes carolinensis | 546 | 14¾ | ♂ | 1-37 | June 4th |
| Harporhynchus rufus | 1158½ | 26¼ | ♂ | 1-44 | " |
| " " | 1170 | 26½ | ♀ | 1-44 | " |
| Regulus calendula | 92½ | 5½ | ♂ | 1-17 | Oct. 5th |
| Regulus satrapa | 97½ | 4 3/10 | ..... | 1-22 | |
| Parus atricapillus | 176½ | 10½ | ♂ | 1-17 | Feb. 26th |
| " " | 159½ | 9 | ♀ | 1-17 | " |

[1] This did not necessitate any injury to the skin, as it was removed by the regular method that is employed in the skinning of birds for scientific study.

| | | | | | |
|---|---|---|---|---|---|
| Dendroica æstiva | 151 | 6¼ | ♂ | 1-24 | May 13th |
| " " | 130 | 5 | ♀ | 1-26 | " |
| " " | 127 | 5 | ♀ | 1-25 | " |
| " " | 130 | 5½ | ♂ | 1-23 | May 20th |
| " " | 138½ | 6½ | ♀ | 1-21 | " |
| " " | 137½ | 6 | ♀ | 1-22 | " |
| " " | 167 | 7 | ♀ | 1-24 | June 4th |
| Dendroica maculosa | 136½ | 5½ | ♂ | 1-25 | May 13th |
| " " | 107 | 5¼ | ♂ | 1-20 | " |
| " " | 122 | 5¾ | ♀ | 1-21 | May 20th |
| Dendroica blackburniæ | 134 | 5½ | ♀ | 1-24 | " |
| Seiurus aurocapillus | 255 | 10¼ | ♀ | 1-25 | May 13th |
| " " | 264 | 11 | ♀ | 1-24 | May 20th |
| Setophaga ruticilla | 59½ | 4¾ | ♀ | 1-13 | " |
| Vireosylvia olivaceus | 355½ | 9 | ♂ | 1-39 | " |
| " " | 304½ | 9 | ♀ | 1-34 | " |
| " " | 238 | 9½ | ♀ | 1-25 | " |
| Petrochelidon lunifrons | 422½ | 8 | ♀ | 1-53 | May 21st |
| " " | 375½ | 8½ | ♂ | 1-45 | " |
| " " | 290 | 8½ | ♀ | 1-34 | " |
| Carpodacus purpureus | 438 | 13¼ | ♀ | 1-31 | May 10th |
| Spinus tristis | 181 | 7 | ♂ | 1-27 | April 15th |
| Zonotrichia leucophrys | 366 | 14 | ..... | 1-26 | " |
| " " | 400 | 15 | ..... | 1-26 | " |
| Spizella socialis | 173½ | 7½ | ..... | 1-23 | |
| Spizella pusilla | 279 | 11 | ..... | 1-25 | April 15th |
| Junco hyemalis | 284 | 10 | ♀ | 1-28 | " |
| Melospiza fasciata | 377 | 12 | ..... | 1-31 | " |
| Dolichonyx oryzivorus | 503 | 15½ | ♂ | 1-33 | May 20th |
| Molothrus ater | 637 | 18¼ | ♀ | 1-35 | May 30th |
| Cyanocitta cristata | 1312 | 46 | ♂ | 1-29 | June 4th |
| Trochilus colubris | 45 | 1 55/100 | ♂ | 1-24 | Sept. 24th |
| Nyctala acadica | 1153 | 55¼ | ♀ | 1-21 | Nov. 2d |
| Tringa minutilla | 388½ | 8½ | ♂ | 1-45 | Aug. 16th |
| Hybrid domestic canary | 346½ | 8½ | ♂ | 1-40 | |
| Passer domestica | 444 | 14 | ♂ | 1-32 | |

| Name of Mammal. | Weight of Body. | Weight of Brain. | Sex. | Relative wt. of Brain to the Body. | Date specimen was taken, 1887. |
|---|---|---|---|---|---|
| Mus musculus | 318 | 5½ | ♀ | 1-58 | June 6th |
| " " | 256 | 6 | ♂ | 1-43 | June 10th |
| " " | 248 | 6 | ♂ | 1-41 | June 10th |
| " " | 295½ | 6 | ♀ | 1-49 | June 11th |
| Spermophilus tredecimlineatus | 2647 | 35½ | ♂ | 1-74 | June 4th |

AQUATIC RESPIRATION IN THE MUSKRAT.—During the winter of 1879–80 I spent much of my time trapping the muskrat, and had rare opportunities for studying their habits. I have frequently observed an ingenious device, to serve as an apparatus for aquatic respiration, resorted to by the animal when driven from its burrow into a pond frozen over. In attempting to cross the pond under the ice, if the pond is too wide for the muskrat to "hold its breath"

until it reaches the opposite shore, it will stop for a few moments and exhale the air which is held down by the ice. Interchange of gases takes place between the air and water, when the animal re-breathes the air and makes another start, repeating the act until the shore is reached. I do not claim this as an original observation; others than myself have noticed it. It is well known by those who have observed the phenomenon that if the ice is struck immediately above the air, and the air thus scattered into numerous bubbles, the muskrat drowns. Having noticed an account by Professor Comstock of the use, by the "water boatman" of a bubble of air for a tracheal gill,[1] I would call attention to this interesting feature in the physiology of respiration of the muskrat.—*W. L. Spoon, Univ. N. C.*, May 1, 1888.

Zoological News.—Cœlenterates.—Dr. G. Hubert Fowler, in the fourth part of his papers on the anatomy of the Madreporaria (*Q. J. Ms.*, 1888) discusses the structure and systematic positions of the genera Madracis, Amphihelia, Stephanophyllia, Stephanotrochus, Stephanaria, Pocillopora and Seriatopora. The points made are mostly of minor importance, except that certain cells described as coral-forming (calycoblastic) cells, occurring in several genera really function to hold the mesenteries more firmly to the corallum.

Echinodermata. — The number of species of Asteroids collectd by the French scientific expedition to Cape Horn is thirty-eight, twenty-three of which are new, while thirty-two were not represented in the museum of the Jardin des Plantes. The number of species known from the southern point of the American continent now reaches fifty-seven. M. E. Perrier finds great variability in each species, correlated with the varying conditions under which they exist.

Worms.—Beddard describes (*Quart. Jour. Micro. Sci.*, 1888) the anatomy of the earthworm *Allurus tetraedrus*, pointing out the features in which this genus differs from Lumbricus and Allolobophora.

Mollusca. — M. H. Fol, in a recent note on striated muscular tissue among the invertebrates, acknowledges that his statement, in a previous communication, that true muscular tissue does not occur in any mollusc is erroneous, since such tissue forms a portion of the adductor muscle of Pecten.

M. H. de Lacaze-Duthiers, as a result of his extensive analytical studies upon the nervous system of the Mollusca, proposes a new classification of the gasteropoda, based upon the differences in the structure of the nervous centres.

[1] Am. Nat., June, 1887.

The marine shells of Fernando Noronha, and indeed most of the marine fauna and flora, are by H. N. Ridley stated to show affinities to those of the East Indies. The species Trochus have a southern distribution.

CRUSTACEA.—Another part of Dr. De Man's Crustacea of the Mergui Archipelago has appeared, embracing pages 177 to 240, and plates 13 to 15. It includes the conclusion of the Grapsidæ, the Leucosoids and the major part of the so-called Anomura. The series is especially valuable from the fact that the author has had access to the types of the French carcinologists. So far the species enumerated number 135.

M. M. Chevreux and Guerne call attention to the amphipod, *Cyrtopheum chelonophilum*, a commensal of *Thalassochelys caretta*, seventy-seven specimens of which have been collected in the scientific voyages of the Prince of Monaco. This species differs from those previously known by the shortness of the antennæ, and is probably a native of both hemispheres.

After Rathke, in 1837, noticed the curious fact that the Palæmons infested by Bopyrus belonged exclusively to the female sex, all succeeding authors have confirmed his observations. Nevertheless, guided by previous discoveries concerning the effects of parasitic castration among certain decapodous crustaceans infested by the Rhizocephala, M. Giard last year gave forth the hypothesis that the facts noticed by Rathke were true in appearance only, and that though all the Palæmons found with Bopyrus seem to be of the female sex, this was really the result of the atrophy of the male organ produced by the parasites. M. Giard has recently been able to verify this supposition, both on European and other species of Palæmon.

MYRIAPODS.—C. H. Bollman publishes in a small pamphlet without indication of place of publication, a preliminary list of the Myriapods of Arkansas. Forty species are catalogued, of which nine are regarded as new.

FISHES.—Mr. George Brook (*Proc. Royal Phys. Socy. of Edinburgh*, x.) monographs the British species of the genus Zeugopterus, enumerating three species, *Z. punctatus*, *unimaculatus*, and *papillosus*, the last being a new species found in the Clyde.

Mr. Geo. Brook (*Proc. Roy. Soc. Edinburgh*, 1887) states that in the trout the segmental duct arises from the ectoderm. Its first appearance is in an embryo of twenty-seven days, when it forms a well-marked thickening in the middle trunk region. The lumen of the duct arises as an irregular cavity, and later the whole tube separates from the ectoderm and sinks into the intermediate cell mass. Some observations that he has made on the chick seem to indicate that a similar origin of the duct occurs in birds.

According to the observations upon the food of fresh-water

fishes, made by S. A. Forbes, and forming Article VII. of Vol. III. of the *Bull. Ill. State Lab. of Nat. Hist.*, eighty-three per cent of the food of the burbot consists of fishes, while *Esox lucius* takes ninety-nine per cent. of fishy food. Dorosoma feeds chiefly on fine mud containing about twenty per cent. of vegetable debris; the golden shad principally on fish; and the Catostomidæ, fifteen species of which occur in Illinois, consume molluscs and insects almost in equal ratio. The stone roller (Hypentelium), which in its habits simulates the Etheostomatidæ, feeds, like the members of that family, almost solely upon the larvæ of aquatic insects. The cat-fishes are nearly omnivorous, and are the only habitual scavengers among the common fishes of Illinois. Amia seems to feed upon Crustacea, fishes, and molluscs, with very little mixture of insect food; the gars entirely on fishes; and the singular Polyodon chiefly upon minute insects and crustaceans, especially the former. Professor Forbes thinks it probable that Polyodon employs its paddle-like snout to stir up the weeds as it advances along the muddy bottom, thus driving the animal forms within reach of its branchial strainer, while the mud and vegetation have time to settle.

Though in the deep-sea fish-fauna no distinct bathymetrical zones, characterized by peculiar forms, can, according to the "Report on the Scientific Results of the Voyage of H. M. S. Challenger," be defined, the abundance of fish-life decreases with the depth, as is shown by the number of species (232) found between 100 and 300 fathoms, as compared with 142 between 300 and 500 fathoms, 7 between 500 and 700, 56 between 700 and 1500, 24 between 1500 and 2000, and 23 below 2000 fathoms.

Partially grown examples of several species of freshwater fishes have recently been successfully introduced into Chili from France. The principles followed in arranging the methods for this long transport, involving five changes previous to the accommodation of the water-cylinders on the steamer Sarata, were as follows: (1) The preservation of the same water. (2) Absence of alimentation. (3) Refrigeration. (4) Continual circulation of air. One hundred California salmon, about twelve centimetres long, forty carp of fifteen cent., twenty tench of twelve cm, sixty eels of thirty cm, twenty barbels, and some burbots, minnows, etc., formed the consignment; out of which thirty-nine salmon, together with all the tench, carp and eels, arrived safely. Many of the other species died.

Dr. J. Brock (*Zeit. für Wissen, Zool.*, 1887), describes a singular appendage present immediately behind the anus in the Siluroid genus *Plotosus*. The apparatus in question consists of a tree-like bunch of small bladders of cavernous, and therefore, probably of erectile nature. The fishes of this genus, are much feared on account of the terrible and often fatal wounds caused by their fin spines.

*Prionurus maculatus* Douglas-Ogilby is a new Australian species obtained at Port Jackson.

Dr. A. Günther (*P. Z. S.*, 1887) describes *Latilus fronticinctus* and *Platycephalus subfasciatus* from the island of Mauritius.

Among the fishes collected by Mr. C. Buckley, in Eastern Ecuador, and described by G. A. Boulenger (*P. Z. S.*, 1887), are three new species of Pimelodus, one of Chætostomus, and *Nannoglanis fasciatus*, a new genus and species of Siluridæ. Among the Characinidæ, *Parodon buckleyi*, *Pia ucina elongata*, and *Leptogoniates steindacheri*, are new, while *Sternarchus curvirostris* is a new Sternopygid.

Reptiles and Batrachia.—Mr. Garman catalogues (*Bulletin Essex Inst.*, ix., p. 119) a collection of Reptiles and Batrachia collected by Dr. Edward Palmer in Texas and Mexico. In all fifty-six species, represented by several hundred specimens. The series of young forms and adults is in some cases very complete. The only new form described is *Crotalus palmeri*, from Monclova, Mexico, which the author regards as a variety of *C. tigris*, though he has not applied to it the trinomial system he advocated a few years ago.

Fred A. Lucas discourses the ever-new question, "Do snakes charm?" in the third number of the *Journal Trenton Nat. His. Soc.* He concludes that the whole effect lies in the person, and that it is no property of the snake.

The warts which appear at certain seasons upon many males of *Rana temporaria*, form the subject of a communication to the *Zeitschrift für Wissenschaftliche Zoologie*, 1887, by O. Huber.

Among the reptiles of Noronha are a species of Amphisbæna, a skink (*Euprepes punctatus*) and a gecko. Batrachians and fresh-water fish are absent.

According to G. B. Howes, the low rank assigned the Discoglossidæ, by Cope, receives confirmation in the distribution of the azygos veins. The same veins led him to the view that their absence in Pelodytes pointed to the Pelobatoid rather than the Discoglossoid relationship of that genus.

The collection of eleven species of Batrachia, and thirty-two forms of Reptilia, brought from Greece, Asia Minor and Grecian Islands, by E. V. Oertzen, is utilized by Dr. Boettger, to throw light upon the sources from which the Ægean Islands received their reptilian fauna. Three of the Batrachian forms are common to the islands and to the mainland on both shores of the Ægean, and may therefore be presumed to be autochthonous, while a fourth is wanting in Candia only. Seven reptiles are spread throughout, and are thus to be considered as belonging to the original stock of the islands. Ten species, otherwise common to Greece, Asia Minor and the islands, are not found in Candia, which has one species of African origin. From the west two species have spread as far as Candia, and three

others have not yet reached that island. Eight forms occur only in Asia Minor and its coast islands.

M. Dollo attacks the conclusion of Dr. Baur that the Athecæ (Sphargis, etc.,) are descended from the Thecophora. He argues that if the carapace of the Athecæ is formed, as maintained by Dr. Baur, by delamination into a mosaic of the carapace of a Thecophorous ancestor, fontanelles ought to exist as in the other Chelonians, which is not the case. Moreover, the oldest genera of Athecæ were without dorsal armor. The fact that the plastron of Sphargis is more reduced than that of the other Chelonians goes indeed to show that the Thecophora cannot be descended from the Athecæ, but it does not indicate the reverse of this. Dr. Trouessart, from various considerations, inclines to the belief that the two groups have descended from a common ancestor by diverging paths.

BIRDS.—George F. Atkinson gives a preliminary catalogue of the Birds of North Carolina, consisting of a list with notes of 255 species and sub-species already observed and an appendix enumerating eighty-one more which may reasonably be expected to occur. In the prefatory account of previous work on the avifauna of the State no mention is made of the labor of Coues and Yarrow at Fort Macon.

According to Mr. A. C. Smith, the author of a recently issued work upon "The Birds of Wiltshire" (Eng.), the Bustard, which in English popular opinion is always more associated with the Wiltshire Downs or Salisbury Plain than with any other part of the country, became extinct there about the year 1820. There seems, in fact, to be no printed account of its occurrence in Wiltshire after that of Montagu in 1813. The Bustard was not extirpated in Suffolk until 1832, nor Norfolk until 1838.

I. H. Gurney gives in "The *Zoologist*" a list of eighteen reported occurrences of *Sterna caspica* in Great Britain, the last in 1880. It is readily identified by its red beak.

The land-birds of Fernando Noronha, according to H. N. Ridley, comprise a Dove, a Tyrant, and a Vireo, yet the group of islands is but 194 miles east of Cape San Roque.

MAMMALIA.—It seems, from Mr. Harting's notes in "The *Zoologist*," that of late years the European mole has extended its range in Great Britain. Writing in 1874, Bell observes that "the mole is not found in the northern extremity of Scotland, nor in the islands of Orkney and Zetland." Alston, writing in 1880, remarks that it was at that date well known in Sutherland and Caithness. Though absent from the island, it is common in Anglesea and in Ayrshire, on the opposite coast. Albino moles are not uncommon.

The only herds of wild white cattle now existing in Great Britain are at the following places: Chartley Park, near Uttoxeter,

Staffordshire (probably enclosed by the middle of the thirteenth century); Chillingham Park, near Belford, Northumberland (possibly enclosed before 1220); Cadzow Park, Lanarkshire; and Somerford Park, near Congleton, Cheshire. Cadzow Park occupies a portion of the old Caledonian Forest. At Blickling and Woodbastwirch, both in Norfolk, offshoots (domesticated) of the herd which once was kept at Middleton Park, Lancashire, still exist. The herd (enclosed at the end of the fourteenth century) at Lyme Park, near Disley, Cheshire, is now extinct. Other herds existed until recently at Colly Deer Park, Ardrossan and Drumlanrig, all in Southwestern Scotland.

Dr. E. L. Trouessart's catalogue of the Carnivora, living and fossil, comprises nearly 700 species. The group is divided into two sub-orders: the Creodonta and the Carnivora Fissipedia, the first of which is arranged under the families Arctocyonidæ, Mesonychidæ, Hyænodontidæ, Leptictidæ, Oxyænidæ, and Miacidæ. The Canidæ are placed with the Arctoidea, which thus corresponds with the Hypomycteri of Cope.

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## ENTOMOLOGY.[1]

New Instances of Protective Resemblance in Spiders.—Within the past two years two interesting cases of protective resemblance have come under my observation. A small species, *Thomisus aleatorius* Hentz, is remarkable for having the two anterior pairs of legs very long, while the two posterior pairs are very slender and short. The spider is very common on grass. One summer day, while reclining in the shade, I watched an individual of this species as it passed from one culm to another. Soon it ran up the stem a short distance and suddenly disappeared from view. For some time I was greatly puzzled as to the manner of disappearance. Upon close scrutiny I saw the spider clinging with its posterior legs to the stem. Its two anterior legs on each side were approximated and extended outward, forming an angle with the stem, strikingly similar to the angle formed by the spikelets.

An undescribed species of *Cyrtarachne* mimics a snail shell, the inhabitant of which during the summer and fall is very abundant on the leaves of plants in this place. In the species of *Cyrtarachne* the abdomen partly covers the cephalothorax, is very broad at the base, in this species broader than the length of the spider, and rounds off at the apex. When it rests upon the under side of a leaf with its legs retracted it strongly resembles one of these snail

[1] This Department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

shells by the color and shape of its abdomen. The two specimens which I collected deceived me at first, but a few threads of silk led me to make the examination. The spider seemed so confident of its protection that it would not move when I jarred the plant, striking it several hard blows. I pulled the spider forcibly from the leaf, and it did not exhibit any signs of movement until transferred to the cyanide bottle. The cocoons which I have found here are also protected by mimicry. They are essentially like those of *Cyrtarachne bisaccata* Emert.[1] They are dark brown, about 12 mm. in diameter, and are provided on two opposite sides with stems made of the same colored silk, about 5 mm. in diameter. The whole structure, which is hung in the branches of some weed, strongly resembles an insect gall made on the stem of some plant. As the species seems to be new, I append a description.

*Cyrtarachne multilineata*, n. sp. Middle eyes on a slight elevation, forming a trapezium, the posterior a little larger and farther apart than the anterior. Side eyes at a distance, very close to each other, also on a slight elevation. Cephalothorax brownish, rising gradually from the low head to the abdomen, which partly covers it, not narrowed behind the eyes, convex on the sides, covered with minute pointed tubercles, the two dorsal elongated prominences ending each in two blunt points. Abdomen triangular, sides slightly convex, angles rounded, ventral surface deeply concave. Anterior one-third of abdomen hair brown mottled with the ground color—ecru drab—a pair of large spots of the ground color near the posterior edge of the brown. On the posterior part of the abdomen are several transverse bars of hair brown, becoming successively narrower and shorter toward the apex. Four of the muscular impressions very deep. Sides and posterior part of the abdomen densely marked with hair, brown depressed lines, starting from near the centre of the ventral surface, and passing up over the dorsal surface of the edge, four of those on the posterior part passing up nearly to the posterior pair of deep muscular impressions. On the ventral surface there is a rectangular spot extending from the spinnerets to the anterior edge, the anterior half of this brown, the posterior white; the depressed lines arise from the sides of this spot. Legs light colored. Described from two females. Length of the larger 13 mm., abdomen 15 mm. broad, 10 mm. long; length of the smaller 11 mm., abdomen 13 mm. broad, 9 mm. long. —*George F. Atkinson, University of North Carolina, Chapel Hill, N. C.*

Note on the Tube-inhabiting Spider, *Lycosa fatifera* Hentz. —There seems to be a general impression that the tube-building Lycosidæ do not use their holes for such a permanent abiding place as do the species of trap-door spiders. Good authorities hold

[1] Trans. Conn. Acad. Sci., vol. vi., 1884, p. 325.

that a majority, and perhaps all, use the tube only as a winter resort, or for a retreat in the summer during the time of molting, though the testimony upon this point is by no means universal. There seems good reason, however, for believing that very nearly all desert their tubes during the spring and summer, at times, and wander in search of their prey. Indeed, there are indications that there are latitudinal, as well as seasonal variations in the habits of the family, *i.e.*, that in northern latitudes proportionately a greater number make no tubes than in southern latitudes. The latitudinal variation might be called generic, in that many species of the genus in northern latitudes hide away under stones, etc., making no tubes at all; while in southern latitudes many other species of the same genus construct tubes, some few using them habitually; many others temporarily. On the other hand, the seasonal variation might be called specific, in that most species, in any latitude, which construct tubes use them only during inclement seasons, or during periods of weakness. One species I have observed here, *Lycosa fatifera* Hentz, habitually uses its tube at all seasons; never, or very rarely, wandering in search of prey. I have many times watched them resting at the opening of the tube, waiting for passing insects. They will dart back into their tubes when alarmed. Hentz reported this species from Massachusetts and Alabama. I have made special investigations upon the species in North Carolina, with a view to establish, if possible, the identity of Hentz's species *fatifera*, and the correctness of his statement that it uses the tube habitually at all seasons. The species can be easily recognized from Hentz's description. The one I find here is the piceous variety, which Hentz reported from Alabama, and not the typical form from Massachusetts.—*Geo. F. Atkinson, University of North Carolina.*

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## EMBRYOLOGY.[1]

THE SEVERAL FUNCTIONS OF THE ENAMEL ORGAN IN THE DEVELOPMENT OF THE TEETH OF MAMMALS AND ON THE INHERITANCE OF MUTILATIONS. — As long ago as 1880 Dr. A. Von Brunn[2] called attention to the fact that the cross crests of the crowns of the molars of the common grey rat were not completely covered with an enamel coating before eruption. The figures then published by Von Brunn showed that the *membrana adamantina* of the enamel organ possessed the characteristic columnar structure

[1] Edited by Prof. Jno. A. Ryder, Univ. of Penna,, Philadelphia.

[2] Notiz über unvollkommene Schmelzentwickelung auf den Mahlzähnen der Ratte Mus decumanus. Arch. f. mik. Anat. XVII., pp. 241–243, pl. XXVII.

over those portions of the tooth covered by true enamel, while at the apices of the cross crests the enamel organ had suffered degeneration of its inner columnar layer and apparently also the reticular portion, as a result of which the organ, just over the crests, had acquired the character of a stratified squamous epithelium. Here and there ragged masses of this tissue seemed to project into the surrounding tissues of the mucous membrane, as if dragged out of place by the gliding of the crowns of these young molar teeth of opposite jaws over each other. These results were obtained from a study of longitudinal sections of recently born rats, with the eyelids still closed, but with the incisors just breaking through the gums.

The great value which the present reviewer attaches to Dr. Von Brunn's earlier observations does not lie in the new histological relations established, but in the discovery that the enamel of the cross-crests of the crowns of the molars fails to develop in the embryo in a situation corresponding to the point where abrasion in the adult through use has slowly worn away this enamel covering and exposed the dentine underneath. This mutilation (for such it is, although produced by an exceedingly slow process of wear), has very clearly been transmitted through heredity. That Dr. Von Brunn should have failed to draw this conclusion from his facts is somewhat surprising, and while glad to call attention to his very important observations, the present writer is of the opinion that these discoveries are amongst the most important made during the present decade as throwing new light upon the method of the evolution of organisms.

In a second memoir [1] Dr. Von Brunn continues his investigations, and adds greatly to his preceding observations. He finds, in fact, that in still earlier stages of the enamel organs of the several kinds of teeth are not different from those normally observed in other mammals, as shown by the tooth germs of the incisors of a uterine embryo of the rat 28 mm. in length. The enamel organs in this last instance are simply cap or dome-like bodies, in which there is as yet no differentiation of the anterior wall as the permanent enamel germ of the enamel band on the anterior face of the incisors of the adult. This is clear proof that profound changes must be suffered by the enamel organ from its earliest appearance until its full differentiation, portions of which evidently must later become either functionless or acquire a new or modified function. This is just what Von Brunn's later researches most conclusively prove. They show, in fact, that in the rat the enamel organ becomes functionless across the transverse crests of the molars before eruption, thus leaving the tooth to erupt with its dentine uncovered at those points. The remainder of the enamel organ which

[1] Ueber die Ausdehnung des Schmelzorganes und Seine Bedeutung für die Zahnbildung. Arch. f. mik. Anat. XXIX. Hft. 3. pp. 367-383, pls. XXI-II, Bonn. 1887.

forms the enamel of the crowns of the molars develop hard enamel, but the portion which extends down over the root and cervix of the molars undergoes degeneration, and its cells lose their columnar form and degenerate into radiating fibres of considerable length, which send their free ends into the surrounding alveolar periosteum. These fibres persist even to adult age, and can be readily seen extending from the tooth into the wall of the alveolus in sections of the entire heads of adult white mice (*Mus musculus*) prepared by the present writer during the last winter. These fibres evidently serve to securely anchor the teeth into the alveolus of the adult, so that the enamel organ is found to have not simply the function usually ascribed to it, but another equally important, namely, the production of these anchorage fibres. Still deeper down in the alveolus the extreme inferior edge of the cap or dome-like enamel organ seems to become quite degenerate and functionless. Such functionless marginal portions of the enamel organ are found in the young of man, the ox, and the rat and mouse. The enamel organ is regarded by Von Brunn in fact as a sort of mould in which the dentine or pulp covered with odontoblasts assumes a definite form. Von Brunn concludes his second memoir with the observation that he considers that he has shown that in the Mammalia, wherever dentine is developed, that the epithelial sheath or cap concerned in the formation of enamel must have first existed. This explains the existence of the enamel organ in the armadillo (Tomes, Q. Jour. Mic. Sci., 1874).

The enamel-forming portion of the enamel organ, after eruption of the molars, is, of course, cast off entirely, or at most persists only as the *enticula dentis*. The portion giving rise to the anchorage fibres of the root persists, as may be seen in longitudinal sections of the molar teeth of adult animals in place in the jaw. In the incisors of the rat, on the contrary, the enamel organ has a more complex history. While it does not differ entirely from the germs of the other teeth in an early stage of development, as all parts of its wall are alike thick, later the anterior wall of this primary enamel organ becomes the persistent enamel organ of the enamel band on the anterior face of the incisors, and thickens, while over the sides and back of the tooth it degenerates and gives rise to the anchorage fibres of these teeth, as shown by Von Brunn, and as confirmed by sections of later stages in my possession.

While the data in which Von Brunn has supplied us are of great interest, there are some which I can add from stages of the development of the teeth of the common mouse, which are of interest in connection with the history of the form of the molars of these commonest of Rodents. A little while before birth the enamel organs of the first and second molars are connected by an isthmus, and it is probable that the germs of the second and third molars are also thus joined together. In longitudinal sections of the heads of young mice it is, however, of great interest to note that the cross crests of the upper molars have their apices directed

backwards and downwards, while the apices of the lower molars slope forward and upward, just as they do in the adult, yet at this stage there has been no enamel or dentine formed. This fact shows that the forms of the crowns are foreshadowed in the germs of the teeth before calcification, and it now becomes possible to assume, for the first time with a reasonable show of probability, that this forward and rearward deflection of the molars is due to an inherited impress or modification induced by the characteristic mode in which the grinding teeth were used in the Rodentia. Because it may be assumed that the manner in which the teeth are used would slowly affect pattern of the crowns, as the writer first tried to show in his essay "On the mechanical genesis of tooth-forms" (Proc. Acad. Nat. Sci. Phila., 1878). It follows that if physiologically induced mutilations may be inherited, as the results of Von Brunn seem to demonstrate, it is almost equally certain that mechanically induced changes of form slowly caused by the normal mode in which the teeth were used could be inherited with probably even greater readiness.

Dr. W. Xavier Sudduth has shown that the reticulum of the enamel organ becomes thinner at the apex of the young tooth. In this way he has also shown that the *membrana adamantina* or inner tunic and outer tunic are approximated while the blood vessels from the adjacent connective tissue are pushed toward the enamel organ to supply it with nutriment and probably aid very considerably in the rapid deposit of the enamel from above, in just the same way as the vascular pulp would supply the conditions for the rapid deposition of the dentine from below. That the enamel organ of the fœtus is supplied by a vascular plexus as assumed by Sudduth is, I think, completely demonstrated by the fact that I find a fine vascular plexus in immediate external contact with the persistent enamel organ of the incisor teeth of the adult white mouse.

The great value which is to be attached to the fact that abrasions of the enamel of the adult, which have reacted upon the funtional activity of the enamel organ of the embryo rat, so that such mechanically induced alterations could be inherited, does not consist so much in the proof it affords that mutilations may be inherited as it does that mutilations incurred in the ordinary struggle for existence, may, under certain conditions in certain practically feral species, be transmitted. The cases which have hitherto been appealed to as proving that mutilations could be inherited are without exception artificial; in the remarkable example of the already abraded apices of the molars of young mice and rats, we have an example of the apparently constant transmission of a mutilation quite independent of any artificial interference whatever. This datum, which has until now been wanting, is therefore at last supplied, and Lamarckianism has found in this the most irrefragable proof of the soundness of its principles. This datum, in fact, is the one needed, as admitted by Weissman, the greatest recent opponent of Lamarck, to place the latter's doctrine in the positions of formidable rivalry to those of Darwin. — *J. A. Ryder.*

## PSYCHOLOGY.

THE RELATION OF WILL TO THE CONSERVATION OF ENERGY.[1] —It is generally supposed that the designed movements of animals exhibit the quality of design by reason of a direct influence exercised by conscious states. It is supposed that an animal eats and drinks because it *feels* hungry and thirsty; that it changes its position because it *feels* that position to be uncomfortable, on account of muscular weariness, unpleasant temperature, or some other reason which is consciously felt by it. Such acts are termed voluntary. They are distinguished from the automatic, which are performed either in the absence of consciousness of them or without that relation of consciousness to them which is seen in the voluntary acts. The peculiar influence exercised by conscious states over acts is termed *the will.* Ordinary will must be distinguished from "free will," since its action is a necessary outcome of "motives" or reasons which pre-exist in the mind; while "free will" is supposed to be spontaneous in its action. With the latter supposititious faculty I have nothing to do in the present paper.

The physiological action of will is as follows, so far as it has been possible to trace it. An impression or stimulus received by a sensory nerve—generally at the surface of the body—is conveyed by it to the posterior column of the chorda spinalis, and is thence transmitted through the optic thalamus to some point in the gray tissue of the posterior lobe of the cerebral hemisphere. Thence a stimulus is conveyed by some of the fibres of the white substance to the anterior part of the gray cortex. Thence it returns downwards, conducted by white fibres, to the corpus striatum, and thence to the anterior column of the spinal cord. From this the stimulus is conducted along the motor nerve to the appropriate muscle, where it releases energy, the muscle contracts, and the act is performed. Modifications of this general procedure depend on the source of the original stimulus, whether from an organ of special sense or from an internal organ, etc., and the part towards which the outgoing stimulus is determined.

The locality at which the outgoing stimulus receives its direction is evidently in the cells of the cortex of the lateral and anterior part of the hemisphere. This is evidently the seat of the will.

I must here recall the familiar fact that multitudes of acts which display distinct design are performed by animals without consciousness having any share in the process. There are good reasons for believing, however, that such acts could never have originated in a state of unconsciousness of the actor. I will not enter this subject

[1] Abstract of a paper read before the Philosophical Society of Washington, May 26th, 1888.

fully, but state in brief what the two principal reasons for this belief are. The first is that, according to our experience, animals which meet with conditions injurious to life which do not cause them pain speedily succumb and perish. It is incredible that animals not conscious of hunger, thirst, and changes of temperature should not speedily die. Animals not conscious of fear of more powerful enemies must be destroyed. The second reason for this opinion is, that all designed acts whose history we can trace are the result of *education*. This means, conscious stimuli strong enough to hold the attention and the repetition of movements appropriate to the stimulus and designed to either retain or escape it, according as it is pleasant or painful. Then follows the acquisition of the power of performing such movements with ease, the consequent withdrawal of attention, and ultimately the absence of consciousness of the performance of the act. This is the process of cryptopnoy,[1] by which acts pass from the voluntary to the automatic stage. There is reason to believe that this is the process by which animals have acquired the various remarkable habits which characterize them and which they pursue with such unvarying precision. But most—perhaps all—animals have not, in so doing, abnegated consciousness. They generally possess enough to enable them to act intelligently in the presence of new occasions and to acquire new habits and add to their stock of automatic capacities. This may be better understood by reflecting on the long ages of geologic time during which they have had the opportunity for such education.

I add here that it is highly probable that the movements thus inaugurated and perpetuated have been made the conditions of the environment, the active factor in animal evolution, since it is probably due to such action that the organography of animals has been determined. This is the probable source of the origin of those variations on which natural selection acts. And the view that organic evolution is due to the consciousness at the back of automatism has been called the doctrine of Archæsthetism.[1]

From this digression I return to the question of the nature of the act of will.

The animal organism is a machine for the metamorphosis of energy; and the evidence is clear that this process is performed in strict accordance with the law of the conservation of energy. The exact relation between the amount of work done and the amount of food ingested is well known, whether that work be muscular, mental, or reproductive. The energy which does the work is liberated by the decomposition of the proteids which constitute the food. These highly complex substances break up, and are replaced during work by simpler and more stable ones, which are eliminated from the organism; while the energy which has maintained them is given up and appears as heat, muscular contractions, thought-force, etc.

[1] Origin of the Fittest.

The animal machine is the most perfect converter of energy known, acting with far less waste than any apparatus of human invention.

Every mental act involves conversion or metamorphosis of energy, whether it be a mere sensation or a memory, an emotion, ratiocination or a determination of will. Throughout these processes the law of conservation of energy is necessarily obeyed. But mental acts possess qualities which require further attention in this connection. Mind, *as such*, is not a form of energy. Reducing mind to its generalized expression,—that one which embraces all its phenomena,—viz., consciousness, it is safe to say that its qualities, and hence its definition, are totally distinct from those which we ascribe to, and by which we characterize energy. Energy is motion in one form or another. Consciousness is self-knowledge, from the simplest sensation upwards. No two subjects of thought can be more widely diverse. In fact, it is safe to say that all thinkable things are traceable to three sources;—matter energy, or the motions of matter, and consciousness, or the knowledge which some matter has of itself. But I assumed at the outset of this paper, in common with most other persons, that designed acts are due to the direction and control of currents of energy exercised by conscious states. In this proposition there appears to be involved an assumption that in an act of will the law of the conservation of energy is violated. This, indeed, appears at first sight to be the state of the case; and it becomes necessary that we examine most fully into the process. It is not assumed that energy is created by an act of will, but it is supposed that energy is directed. The creation of energy is unthinkable. Let us see whether the idea of its direction by some thing which is not energy is a fact of experience or not. Believing, as I do, that consciousness, and hence will, is a phenomenon of a material tridimensional basis, and disclaiming the dualistic idea that consciousness is external to and apart from tridimensional matter, it is necessary to explain how such an attribute or quality is capable of exercising control of the movements of such physical basis. Having already expressed the belief that it does so, let us look into the *modus operandi*. I believe that this may be expressed by the following law. *The dynamic expenditure of an act of will has no dynamic relation to the nature of the decision involved in it.*

This law may be illustrated as follows, in the case of the lower animals. An animal which is pursued by another may run into a hole or it may ascend a tree for safety. In the two cases totally different sets of muscles are used. The animal, *for reasons*, elects to use the one set rather than the other set. Another animal may throw one ear forward to catch a sound rather than the other ear. Mechanisms to accomplish the movements of both exist. In this case the animal *directs* the energy to one set of muscles rather than to the other. Or an animal will use both ears alternately, or turn the head from side to side to hear and see what is behind, each time choosing which muscles it will move. This is only the common will of the animal

acting from the simplest of motives—not free, of course, but none the less a remarkable property of protoplasm, conscious and unconscious. No inorganic machine can do this.

What relations do these decisions bear to the amount of energy expended in the resulting act? A physical movement costs energy, and a mental act costs energy. The mental activity incident to a decision of will costs energy, and the more perfectly ratiocination is performed, the more perfectly is the energy consumed and the less dissipated, as heat. But does the decision to use the left hand, eye, or ear cost more or less than the decision to use those of the opposite side? Evidently not. Does the decision to climb a tree cost more than the decision to enter a hole? I venture to say that it costs a man no more to decide to build a house than to decide to stand a brick on end, so far as the act itself is concerned. This is because the act is the outcome of a process of ratiocination or feeling, in which the dynamics are not correlated to the forms of the sensations embraced under those two terms. The fact of anything being done *for reasons* indicates that it takes its direction from other than dynamic sources. The question of the decision is quite different from that of acquiring motives of action. This is a more complex process, for motives are reached by very various routes. But even in attaining motives there can be no equivalency between the energy expended and the mental result.

Of course it may be said that there is no separate act involved in a decision of will. It may be correctly said that the determination is simply due to the predominating pressure of the most important and weighty motives. Let this be accepted as true. It is consciousness, past or present, which knows which are the weighty motives. Like the prism which bends the course of the rays of light, whatever passes through the psychical connection between incoming and outgoing stimulus is determined in accordance with what it finds there, and it is consciousness and its residua which is responsible for the bending. The physiological labor is performed in acquiring the motives which, when acquired, perform acts of will which are incommensurate with energy, both with regard to their own intrinsic qualities and with regard to the objects towards which they act. It is this property of mind which enables it to direct the movements of matter without violation of the law of the conservation of energy.

This fact is of the utmost importance to philosophy and to our conceptions of the universe and of the place of consciousness in it. These decisions, which we term will, are common to all conscious beings, from the bottom of the scale up. Every animal which selects an article of food or which rejects one, for *reasons*, lowly and simple though they be, performs an act of will, and directs energy, and in so far appears to be superior to the law of the conservation of energy. With the lapse of consciousness, such as we see in the vegetable kingdom, acts of will—prop-

erly so called—are impossible. Their automatic residua remain to work blindly forward until such time as the environment changes to unfavorable conditions, when the organism perishes without remedy.—*E. D. Cope.*

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## ARCHÆOLOGY AND ANTHROPOLOGY.[1]

FRAUDULENT SPEAR OR ARROWHEADS OF CURIOUS FORMS.—We have just received a series (eight in number) of these curious-shaped spear or arrowheads which were transmitted to us for our inspection. We were not informed whence or from whom they were purchased, nor who was suspected in connection therewith. But a slight examination developed the fact that they were spurious. The material used was black and jaspery flint or chert which takes no *patine* with age or exposure. The fresh fractures have much the same appearance as have the ancient ones. A critical examination, however, under the miscroscope, and in other ways knows to the archæologist accustomed thereto, detected the fresh chipping done at the places necessary to make the curious form. We were thus enabled to supply the outline where it had been chipped away, and could see the genuine implement as it was before subjected to the dexterous manipulation, or slight of hand, of this modern manufacturer of spurious flints. Five of the specimens had been made from the common leaf-shaped spear or arrowhead. In two cases stemmed arrowheads were used, and the last was triangular with a concave base. From these original and genuine forms the manipulator had made his curious forms. The originals were worth, say, two cents a piece, but after being subjected to his adroitness their price would be increased to fifty or seventy-five cents. A fine speculation! A law is sorely needed in the United States by which these fine gentlemen can be prosecuted for such deceitful practices, as they now can be for passing base money.

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

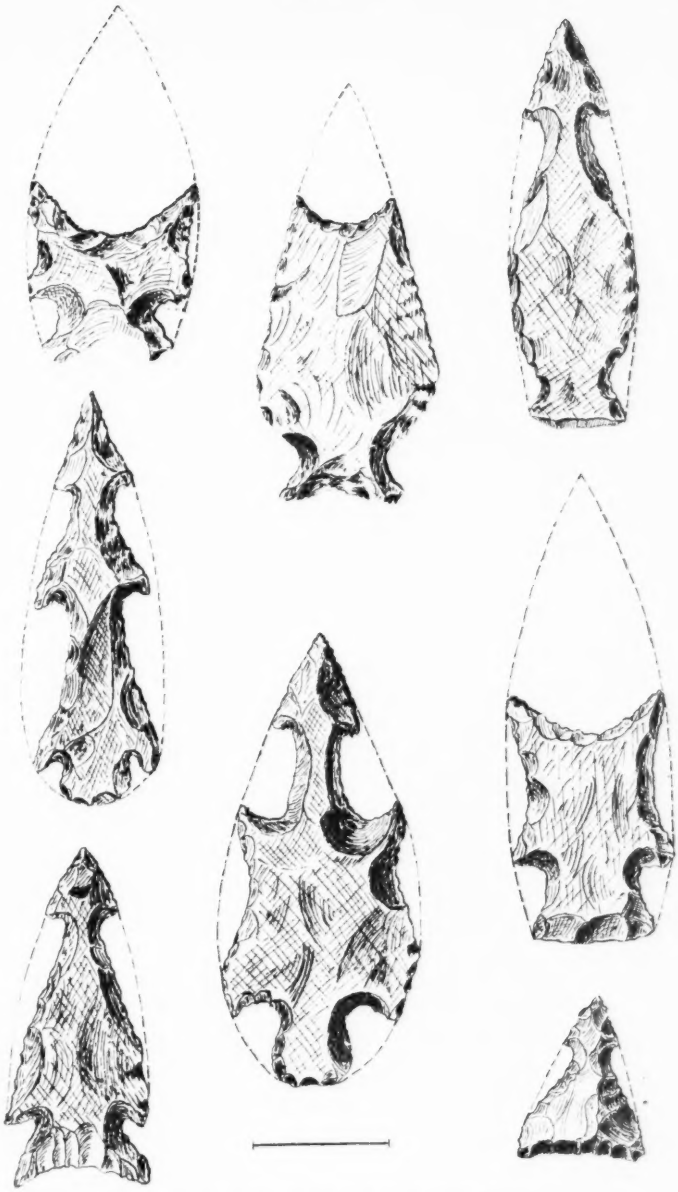
THE HEMENWAY EXPEDITION IN ARIZONA. — Dr. Jacob L. Wortman, of the United States Army Medical Museum, has just returned from Arizona, where he has spent the winter and spring attached to the Hemenway Southwestern Archæological Expedition under the direction of Frank Hamilton Cushing, which was mentioned in the March number of the NATURALIST, and he confirms the importance as well as the genuineness of the discoveries of Mr. Cushing. The expedition is thoroughly equipped and well organized, and its investigations have been conducted in a vigorous and scientific manner, with special reference to the many details which go to make collections of this character of value to the scientific student. Not only have the ruins been carefully surveyed and mapped, but each specimen has been labelled with great care, in such a manner as to indicate exactly where found, together with all such other facts in connection with it as will be of use to the student.

The expedition has for its object the study of the ancient civilization of the southwest, and if the results of the first year's work can be taken as an index of what it will accomplish, we may confidently look for a solution of this perplexing question. Already a large and valuable collection illustrative of the culture of these prehistoric people has been secured, and it is a matter of congratulation that it has been so collected that the scientific student can get all out of it that it can be made to tell.

Mr. Cushing's ethnological training has been in such a direction as to give him a peculiar fitness for the position which he occupies, having spent six years or more in studying the social institutions, customs, habits, religion and language of the modern Pueblo Indians, and this thorough knowledge of these is indispensable to the proper interpretation of the facts gathered by the expedition. The anthropological work is in charge of Dr. Herman Ten Kate, a native of Holland, son of the distinguished artist of that name. Dr. J. L. Wortman, the Anatomist of the Army Medical Museum of Washington, is his assistant. Mr. Adolph Bandelier, whose knowledge of the early Spanish and Mexican records is well known, is connected with the expedition as historian. Mr. Chas. A. Garlick is the civil engineer and topographer. Mr. Fred. Hodge is the draftsman and secretary, while Mr. Yates is the photographer. Mrs. Cushing and her sister, Miss Margaret Magill, are also members of the party, and have rendered important aid in the classification and care of the specimens. Miss Magill's artistic talents have been of special service to the expedition by reason of her clever sketches and drawings of the specimens *in situ*.

The locality in which explorations have so far been conducted comprises the Gila and Salt River Valleys, situated for the most part in southwestern Arizona. They are fertile tracts of large extent, and there can be little doubt that they were once occupied by a thrifty and prosperous people, whose history remains unwritten. The Rio Salado (Salt River) is the principal tributary of the

PLATE X.



Spurious Arrow Heads, made from genuine bones.

Gila, and affords abundant water to irrigate its valley, a tract including a half a million acres, or more. The land for the most part is covered with cactus, sage brush, grease wood, and mesquite trees, but when cleared and brought under irrigation is made to produce abundantly almost any and all the crops of civilized husbandry. Fruits and cereals grow in profusion, and the land is said to be well adapted to the growth of cotton and tobacco. The land rises from the river at a gentle slope, a fact which is of great importance to a system of irrigation. At the upper or northwestern end of the valley, however, the river is bordered upon the south by a mesa which slopes away to the Gila, no mountains intervening between the streams at this point. Water brought from the Salt River upon this mesa can be made to flow a distance of twenty miles to the south, or into the Gila, and will irrigate a tract many miles in extent. This these ancient people did, and, scattered over this plain from the Salt to the Gila are to be found the ruins of their villages, towns and cities, long since crumbled into dust, and now overgrown with a thick mesquite forest.

Their houses were for the most part built along the main irrigating canals, and are now indicated by irregular truncated mounds, of various dimensions, thickly strewn with fragments of broken pottery. Excavating these mounds, the foundations or ground plans of the buildings were discovered. Some of them were large, often several hundred feet square, and, according to Mr. Cushing, three or four stories in height. They were constructed usually of adobe bricks, but in some instances they enclosed the adobe between rows of upright posts wattled with cane or willow. Each house would contain from two to five hundred rooms, and is thought by Mr. Cushing to have been the house of a clan. A considerable grouping of these communal houses constitutes what Mr. Cushing has called the cities of Los Muertos, Los Hornos, Los Guanacas, Los Pueblitas. Los Acequias, etc. They are not built with the regularity of our modern cities. Los Muertos (the city of the dead) can be traced for three or four miles, and includes some forty or fifty of these great communal structures that have been so far unearthed, but if systematic search be continued double or quadruple this number will probably be found.

A characteristic feature of each of these cities, and one which probably led Mr. Cushing to designate them as such, is a ruin of much greater dimensions than any of the rest, which is invariably surrounded by a strong outside wall, enclosing a considerable space or yard. This enclosed space around the large building or temple is supposed to have been for the purpose of protection in times of war, when pressed by an enemy, and the large building itself served not only as a store house for a reserve supply of provisions, but also, if we are to judge from the remains and implements, was the abode of the ruler or chief priest of the people of the town.

While no accurate computations have been attempted, it is supposed, taking into consideration the number of towns or cities known to have existed in the Gila and Salt River valleys, that the population could not have been less than two hundred thousand. There is every reason to believe that these places were not successively, but simultaneously occupied, especially when we remember that they constructed large irrigating canals for a distance of fifteen or twenty miles, which with their rude implements must have been a gigantic undertaking. Their irrigating system was extensive and complete, and covered almost, if not quite, all the cultivable parts of the two valleys. The present inhabitants of the soil have taken advantage of these ancient waterways, constructed at such expenditure of prehistoric labor, and they now run many of their irrigating canals in these ditches. These ancient canals were constructed with care. A cross section exhibits a series of terraces widening towards the top, so that a large or small quantity of water could be accommodated and a good depth secured. After the canals were dug they were puddled and then burnt, probably by filling them with brush and then setting it on fire, so that they almost equalled terra cotta in durability. Mr. Cushing is of opinion that they were not used for irrigation alone, but for navigation as well. There are indications that they used rafts made of reeds (balsas) for navigating these canals, and this appears more probable from the heavy materials that have been brought from a distance. It seems certain that they floated the pine timber used in their building operations down the Salt and Gila Rivers from the distant mountains; it is too much to suppose that they carried this material upon their backs for a distance of a hundred miles.

The burial customs of these people were peculiar and consisted of two methods, viz., cremation and interment. In the case of the priestly class the body was wrapped in cotton cloths and deposited beneath the floor of the house. Generally the bodies were laid along the east wall of the building, with head to the east, although this custom was not invariable. When a person of this clan died, a grave was dug in the floor, a foot and a half or two feet deep, and the body placed therein; it was then covered with adobe mud and packed firmly around the corpse. When this covering dried, and the soft parts and wrappings disappeared, the skeleton would be found enclosed in a rude sort of sarcophagus. In numerous instances, two, and more rarely three, skeletons were found in one grave. In all such cases of double or triple burial the skeletons indicate that it was male and female, or one male and two females. Buried with each cadaver was a food vessel and a water jar, and sometimes several of each, often highly decorated. That they were wrapped in cloths, presumably of cotton, is evident from the impressions of the cloth made upon the soft adobe covering. Fragments of this material were found and preserved, notwithstanding its decomposed condition.

Connected with each communal structure is what Mr. Cushing aptly terms a pyral mound, since the bodies of the common class were burned and their possessions destroyed upon this spot. The ashes and fragments of the charred bones were collected and placed in a burial urn, which had been previously "killed," and the whole buried in close proximity to the spot. The accumulations of this charred and fragmentary material now make mounds of sizable dimensions, which in itself would indicate a long period of occupancy. In the case of the pyral burials everything was broken and destroyed, while in the priestly burials the accompaniments were always whole. In one case of the priestly burials not only were the usual accompaniments present, but a quantity of arrow points, spear-heads, and a large stone knife, together with numerous turquoise ornaments and materials for inlaying, were found deposited in the grave. This individual Mr. Cushing identified from his paraphernâlia as belonging in all probability to the priesthood of some war order, and this seems more probable when we come to examine the skeleton, for he had sustained a fracture of the arm, and one knee was stiff from anchylosis, no doubt the scars of hard-fought battles.

Of the priestly burials something like four or five hundred were unearthed in the various towns, while many more of the cremated remains were found in the vicinity of the pyral mounds. The skeletons, as a rule, were so frail that comparatively few could be preserved. Of the whole number about one hundred good skulls, and probably fifty tolerably complete skeletons, were collected. These were so frail that Dr. Wortman was compelled to use a goodly supply of shellac varnish to keep them from falling to dust. Silicate of soda was tried, but it was not found so good as the ordinary shellac dissolved in alcohol.

The objects which go to make up the collection are various, and consist of those of ornament and utility. Numerous shell carvings, some of which had been beautifully inlaid with torquoise, were found, while a very few copper ornaments in the shape of bells and earrings were also dug up. Their tools consist almost entirely of stone, and were, for the most part, polished, though such implements as potters' stones, rasps, mauls, metates, etc., were never polished. Their stone axes and hatchets are of the ordinary pattern, and are generally well polished; they are of various sizes and shapes, and some of them were no doubt used as picks in digging up the hard cement and gravel in the construction of their irrigating canals. Stone hoes, knives and arrow-heads were also found in abundance.

The collection of pottery is large, and, according to Mr. Cushing, resembles that of the Zuñi manufacture more than any other people. It is often highly decorated with quaint and unique patterns, in various colors, and some fragments exhibited a fine glaze, which indicates a high state of the ceramic art.

That they were acquainted with metals there can be but little doubt, although they do not appear to have made use of it except in the way of ornament. Some places in the neighboring mountains seem to indicate that they mined for ore, which they smelted in crude ovens. Whether this was copper or the precious metals is now difficult to determine, but that they were accustomed to bring these ovens or furnaces to a very high heat is indicated by the slag in their immediate vicinity.

It is perhaps premature to attempt to decide who these people were, to whom they were related, and what became of them, I think it fairly settled by these discoveries that they were the ancestors of the modern Pueblos. Whether or not they were in any way connected with the ancient people of Mexico and Yucatan the future alone can decide. It seems certain, however, that one part of them went north to found the later Pueblo civilizations which are now represented by the Zuñis of to-day.

If historical evidence is worth anything and if we can trust the ordinary evidences of archæology, then these ruins are beyond question pre-Columbian, and may be as much as a thousand years old.

Mr. Cushing's final report will be awaited with interest by all who are in any way interested in the subject. The archæological specimens have been shipped to Salem, and the skeletons will go to the Army Medical Museum in Washington.

The Indians of British Columbia[1] are made the subject of a short article by Dr. Franz Boas, who had the opportunity of studying during three months of the year 1886 several southern tribes of this connection. During that short lapse of time Boas has largely increased our knowledge of their tribes, tribal names, synonymy, and habitat, and has also gathered so much of their dialects as to enable us to divide them into linguistic families. The seven pages of Boas's article (pp. 422–428) presently before us are chiefly filled with mythologic information, which for that special country is almost wholly new to us. Boas believes that the raven legend originally belonged to the Tlinkit and their immediate neighbors, but that, on the other hand, the sun legend originated with tribes of Selish lineage (and many of the other North American Indians, he might have added). Other deities appearing in these parts are Tsonokoa, a mythical form of the grizzly bear; Komokoa, a water spirit, the father of the seals; the Sisiutl, a double-headed snake, and a number of others. British Columbia is perhaps the only spot in North America where cannibalism (a milder sort of it) is still practiced. This is the case among the Tsimpshian and the Indians on the mainland opposite Vancouver Island, who possess a sort of clan called the cannibals,

[1] Proceedings of the American Philosophical Society of Philadelphia, November, 1887.

and a dance peculiar to the rite. From the same author[1] we have received a few other publications, which refer to the sights seen and facts gathered by himself among the distant tribes visited by him.

"THE INDIANS OF BRITISH COLUMBIA," it is an article giving his experiences chiefly among the fishing tribes of the channel between Vancouver Island and the main land. The number of the Indians at present living in British Columbia is put down by Boas at 38,500 (p. 635). "A Year among the Eskimo" in *Bulletin of American Geographical Society*, New York, 1887, pp. 383–402, impart to us some ideas how the Eskimos of the shores of Baffin's Bay make their living during the trying winter season of these high latitudes, and also adds myths and songs of this strange people, especially the Sedna legend. This same legend of the Central Eskimos, together with other stories and traditions, are more especially dwelt upon in "The Eskimo" in *Transactions of the Royal Society of Canada*, 1887, pp. 35–39. Curiously enough, the *thunder* is a prominent feature in the mythology of these frosty climates (p. 37). Mythologic traits of all the Northwestern tribes are discussed in some German articles of Boas in the *Globus* of Braunschweig, 1888; the first of these legends is contained in No. 8, pp. 121–127; the second in No. 10, pp. 153–157. The Sedna legend, together with a considerable number of other mythic tales, legends and stories of these parts, is reproduced in Boas' article: "Die religiösen Vorstellungen and einige Gebränche der zentralen Eskimos," (*Petermann's Mitteil.* 1887, pp., 302–316.) His full enumeration of the villags and settlements of the Kwakiutl people will be found in "Census and Reservations of the Kwakiutl Nation," with map. (*Bulletin of the Am. Geograph. Society,*) 1887, No. 3., pp. 225–232.

"THE GEOGRAPHY AND GEOLOGY OF BAFFIN LAND."[2]—Ethnologic information, whenever obtained with accuracy and correctness, must be published *without delay*. Mindful of this principle, Dr. Boas has, ever since the above was written, been busy in publishing the results of his voyages in various periodicals. Thus we have seen of him, besides the articles in *Globus* appearing as a serial, a treatise of which the title is mentioned above, and another of eleven columns in "Ausland" of Stuttgart, 188, pp. 281–286, entitled, "Die Indianer des britischen Columbia." This paper contains a series of some of the author's most thrilling experiences on his travels on Vancouver Island (east side) and the mainland opposite. The principal myth of these Kwakiutl tribes contains the achievements of Qanikila, or the "Wanderer," who is reputed to be the Son of God, and sent by God from the heavens

[1] Popular Science Monthly of New York, March, 1888, pp. 628–636.
[2] Trans. Royal Society, Canada, pp. 75–78, 1887, and an article of eleven columns in "Ausland" of Stuttgart, 1888, pp. 281–286, entitled, Die Indianer des britrschen Columbia.

to visit all countries of the earth and perform miracles. This belief makes these Indians very accessible to a future conversion to Christianism; but the Catholic missionaries were not successful with them up to this day, because they neglected to use the main impulse for civilizing savages: *to make them work* and earn money.

THE MOTILONES[1] are an Indian nation scattered in numerous bands or tribes through the Eastern Columbian and the Western Venezuelan States, many living south of the Lake of Maracaibo. The Motilones living in the forests and swamps between Zulia and Cesar Rivers, on the border line between the two confederacies, have been very dangerous neighbors to the white settlements ever since the conquest. The name is equivalent to "pelon," *baldheaded*, and also applies to a denomination of monks, who tonsured their hair so as to appear almost baldheaded. It is, therefore, not a name belonging necessarily to one tribe or race only, and indeed we find it repeated in several parts of South America. From 1779 to 1792 the Spanish domination established ten missions among the Motilones on the Zulia, of which even the last trace has disappeared in our days. Dr. A. Ernst, Director of the Ethnologic Museum in Carácas, Venezuela, and one of the few men of education who are active in the furtherance of South American anthropology, obtained from General B. T. Velasco the skull of a Motilone man, about forty-five years old, for measurement. He found it to be chamæprosopic and but a little hypsicpehalic, the index for length and width being 79.9. He describes the skull, adding to his accurate measurements all what is known about the tribe of the Motilones.

At the same session a report by A. Ernst was read concerning the language of the *Tucurá Indians* in the Columbian States. Tucurá is a settlement upon the Upper Sinu, at the mouth of Rio Verde, and these Indians form a population of about seventy. The vocabulary obtained from the traveller, F. A. A. Simons, is printed in the *Verhandlungen*, p. 302, and contains some Carib terms, many of the terms being oxytonized.

Two weeks later, another communication from Dr. A. Ernst was read in the Berlin Society, containing a vocabulary of the Motilon language, the first one ever obtained from that tribe. It was obtained by Mr. George Isaacs, Secretary of the Scientific Commission, presided by the French naturalist, Charles Manoen, and appeared first in the *Anales de la Instruccion publica de los Estados Unidos de Colombia*, VIII., pp. 213–216, Bogotá, September, 1884. Dr. Ernst republished this vocabulary of seventy-two terms, and finds that twenty-four among them connect this language with Macusi, Arekuna, Akawai, and other Carib dialects. Cf. *Verhandlungen* of May 7, 1887, pp. 376–378.

[1] **Verhandlungen der Berliner Anthropologischen Gesellschaft, April 23, 1887.**

## MICROSCOPY.[1]

IMPROVEMENTS IN THE PARAFFIN AND CELLOIDIN METHODS.—The great advantage of the paraffin method is that it permits of making ribbons of thin sections with great rapidity. But material that has passed through this method of imbedding invariably loses something in the *clearness* of its finer histological details, as may be seen by comparison with sections made in elder pith or in celloidin. In some cases structural features are obliterated, or obscured to such a degree as to be beyond detection. As Dr. Apáthy has pointed out, this is especially true of connective tissues and intercellular substances. Can the paraffin method ever be improved so far as to be free from this very serious objection? or can we find a substitute that will have the advantages without the disadvantages of paraffin? Celloidin is free from the objection just mentioned, and it has the inestimable advantage of being a perfect safeguard against brittleness and loss or displacement of loose parts. But the celloidin method is complicated, and does not admit of very thin sections or of ribbon-cutting. Dr. Apáthy has shown us how the serial arrangement of section can be accomplished with the celloidin method, but the process recommended is slow and tedious compared with that of ribbon-cutting. Dr. Kultschizky[2] proposes to combine celloidin with paraffin, and thus to secure the advantages of both and neutralize the defects of each. I have not yet tested Kultschizky's method, but it certainly seems to be the most promising thus far described. It is probable, however, that the *definition* of histological elements will suffer no less by this than by the ordinary paraffin method. Professor Ryder has given the method a trial, and recommends it very highly. Ryder's description is very complete, and, as he suggests some improvements, I shall follow his account.[3]

*The Celloidin-Paraffin Method.*—1. The object to be sectioned is placed in strong alcohol (97 per cent.) until dehydrated or until fully saturated.

2. It is then placed in a mixture of equal parts of ether and alcohol until saturated, the time varying with the size of the object.

3. It is then transferred to a solution of celloidin, prepared as usual in equal parts of alcohol and ether, and in which it is allowed to remain for twenty-four hours.

4. The object is then placed in oil of origanum until saturated, which will be in from one to two or three hours according to the size of the object.

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] Zeitschr. f. wiss. Mikroskopie, iv., 1, p. 48, 1887.

[3] J. A. Ryder. Celloidin-Paraffin Methods of Embedding. The Microscopical Bulletin and Science News, Dec., 1887, p 43

5. It is then transferred from the preceding to a mixture of equal parts of oil of origanum and paraffin, which is kept on a water bath for an hour or more, at a temperature of 40°C.

6. It is then transferred to a bath of hard paraffin, or such as melts at 55°C., and is kept there until saturation is complete.

I have tried this method with specimens of injected spleen, and find it to work admirably. The sections can be cut with a dry knife. The sections form a ribbon more easily than in the case of ordinary paraffin imbedding.

The sections may be freed from paraffin with *chloroform* before mounting if they are required for histological purposes, as they may be handled with the greatest ease on account of the presence of the celloidin which holds them together. They can then be stained in hæmatoxylin (Kleinenberg's) or in nigrosin, or double staining effects may be produced by the use of other dyes in combination with hæmatoxylin.

To many persons the oil of origanum has a disagreeable odor, and is almost as inflammable as turpentine; besides, it darkens or oxidizes in a short time, and has, I think, a tendency to shrink the object slightly, even after treatment with celloidin, and also to darken it.

These disadvantages I have lately avoided by substituting chloroform for the oil of origanum, used by Dr. Kultschizky. I proceed in the same manner as he recommends with the imbedding process as regards the first, second, and third steps. The fourth step is to place the object soaked with celloidin in the usual way in chloroform until saturated, instead of in oil of origanum. It is then transferred to a mixture of paraffin and chloroform, equal parts, kept at a temperature of 40°C., and finally, until complete saturation is effected, in molten hard paraffin melting at 55°C.

To clean the sections for mounting, they may be mounted directly from the chloroform, if the operator is quick enough and does not let the chloroform evaporate from the section before it is covered with balsam. A preferable clearing agent, first proposed by Wiegert, I have found to be a mixture of equal parts of *xylol* and pure white *carbolic acid*, which has been allowed to deliquesce or rendered liquid by heat. This may be applied to the section on the slide with a clean camel's-hair pencil, and will clean the section instantly without in the least attacking the celloidin.

*Serial Sections with Celloidin.*[1]—The celloidin block, with the object imbedded, is cut as regularly as possible, and fastened to a cork. In sectioning, the knife should be placed nearly parallel with its direction of motion, and after every five to ten sections wet with 95 per cent. alcohol. The sections are raised from the knife with a small brush, and placed on the surface of bergamot oil (in a small glass dish over a white ground). If the oil is good the sections will at once unroll and become transparent.

[1] J. Apáthy. Methode zur Verfertigung längerer Schnittserien mit Celloidin. Mitth. a. d. zool. Station z. Neapel., vii., 4, p. 742, 1887.

Bergamot oil is in every respect the best to use in celloidin technique. Origanum oil may be used, but its action is violent and often causes the colors to fade. Good bergamot oil is clear grass-green, with at most a slight yellow tinge (yellow oil is always bad), does not smell of turpentine, and mixes with 90 per cent. alcohol without turbidity or formation of water drops on the surface. The little cloudiness produced by breathing on the latter, should at once disappear. Aniline colors ought not to fade perceptibly in bergamot oil even after forty-eight hours; while celloidin ought not to be softened by it in the least; on the contrary, sections that have been softened by strong alcohol should acquire greater firmness in bergamot oil.

Tracing paper must first be cut into strips about as broad as the object-carrier, and at least three times as long as the cover-glass. The shape of the latter is marked on one end of the strips. The paper must be perfectly smooth, well oiled and transparent, and unite some stiffness with flexibility. The strip should be held by its free third, horizontally, in the oil, supported from beneath by the middle and third fingers, and held from above by the thumb and first finger, so that a slight longitudinal and upwardly directed concavity can be given to it. Thus the immersed end of the paper, on which the sections are to be arranged, can easily bear a slight weight without bending. Now, while the left hand holds the strip of paper over the surface of the oil, the right draws the sledge of the microtome with the little finger, and also turns the micrometer screw. Between the middle and third fingers of the same hand, a fine elastic brush is held, supported by the ball of the thumb, and between the first and middle fingers and the thumb a very sharp but strong dissecting needle. The section is removed from the knife, where it lies in plenty of 95 per cent. alcohol, with the brush, and put on the oil; here it is followed with the strip of paper held beneath and guided near the position where it should lie; then drawn with the needle out of the oil on to the paper. The sections are arranged in cross rows, which are held from 2 to 3 mm. out of the oil to prevent them from swimming away. The rest of the paper remains in the oil and is only withdrawn as it is covered with sections. When the desired number of sections has been brought into order on the paper, the oil is drained off, and the paper is then turned so that the sections face downwards. In this position the strip is allowed to fall slowly on the object-glass. Then it is flattened out with a dissecting needle and dried with blotting-paper. Now the tracing-paper, through which the whole series can plainly be seen, must be carefully removed, leaving the sections on the object-glass. If any sections should remain on the paper, the latter, after the sections in question have been moistened with oil, is replaced in its former position on the object-glass, pressed a little, and then removed, or if the sections are quite dry they may be taken with pincers and transferred to the object-glass.

As soon as all the sections are in order on the object-glass, the smooth surface of the blotting-paper is laid on it and stroked lightly several times with the finger to remove all the superfluous oil.

The Canada balsam and cover-glass maynow be added without danger of displacing the sections. Entire removal of the oil insures the preservation of the most fugitive colors. The sections should not be placed near the edge of the cover-glass, as every discoloration begins at the edge.

In the foregoing manner, over 100 sections were placed in a complete series under one cover-glass, in as short a time as by the paraffin method.

As celloidin, like paraffin, does not readily penetrate chitinous envelopes, cuticula and cocoons, care should be taken :—

1. To use at first very thin solutions, which should be gradually brought to the concentration which the imbedding mass is to have

2. To imbed twice, the first time merely to cut the object in pieces, or open a cocoon, or cut etc., with the microtome.

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## SCIENTIFIC NEWS.

—The American Association for the Advancement of Science will hold its thirty-seventh meeting at Cleveland, commencing August 21st, under the Presidency of the Hon. J. W. Powell, of Washington, D. C.

—The International Geological Congress will hold its fourth meeting in London, commencing September 14th. The honorary president is Professor T. H. Huxley, who is also president of the organizing committee. The Acting president is Professor J. Prestwitch.

—The British Association for the Advancement of Science holds its annual meeting at Bath this year, commencing September 5th. The President is Sir Frederick J. Bramwell.

—The Annual Excursion of the Geological Society of France will be this year in the neighborhoods of Commentry, Chateauneufe St. Germain des Fossés, Moulin and St. Armand. A great range of geological formations will be visited.

—Professor Charles Linden, of the Buffalo High School, died in Buffalo, N. Y., February 3d, 1888, aged fifty-six years. He was born in Breslau, Germany, and came to this country at an early age. His studies were in the line of ornithology, and he made collecting expeditions to Florida, Brazil, the West Indies, and Labrador.

—An obituary notice of the late Professor F. V. Hayden, from the pen of Professor J. P. Lesley, occurs in the *Proceedings* of the American Philosophical Society, Vol. XXV.

—The first part of the eleventh volume of the *Journal of the Cincinnati Society* of Natural History contains a general index to the previous ten volumes.

—The annual report of the Essex Institute (Salem, Mass.) shows that society in a prosperous condition. The additions to the library for the year aggregate 20,739 entries, while the income for the year, exclusive of legacies and special funds, amounted to $4,405.

—A new zoological station is to be started at Ostend. It will be supported by four Belgian universities.

—The Linnean Society of London celebrated its hundredth anniversary May 24th, 1888. Among other features of the centennial were the reading of a eulogium upon Linnæus, prepared by his successor, Professor Fries, of Upsala; one by Sir Joseph Hooker, upon Robert Browne; one by Professor Flower, upon Charles Darwin, and one by Professor P. W. T. Thistleton Dyer, upon George Bentham. The council has decided to establish a Linnean gold medal, to be awarded to a botanist and a zoologist in alternate years, and the first award was made to Richard Owen and Sir Joseph Hooker.

—The meeting of the British Association for the Advancement of Science will be held this year at Bath, beginning September 5th at 8 P.M.

—J. Jverson has been sent by the University of Christiania to Sumatra to make zoological collections for the University.

—The first and second parts of the monograph of the weaver-birds (Ploceidæ) and arboreal and terrestrial finches (Fringillidæ), by Edward Bartlett, The Museum, Maidstone, Kent, England, is now ready for circulation. Price, 10*s*. 6*d*. each part.

—Willard A. Stowell, 222 Second st., Trenton, N. J., is preparing a catalogue of all North American Ferns, embracing in that area Mexico, Central America and the West Indies. He desires notes and exchanges.

—Professor Harrison E. Webster, of Rochester University, has recently been elected President of Union College, Schenectady, N. Y.

—The Association of German Naturalists and Physicians holds its

annual meeting this year at Cologne, beginning on September 18th and continuing until the 23d.

—Flower's Osetology of the Mammalia has been translated into the German by Dr. Hans Gadow.

—For over fifty years Karl Ernst von Baer's "Über Entwicklungsgeschichte der Thiere" has remained incomplete. At last, Dr. L. Stieder, of Königsberg, has issued the fourth (last) part from von Baer's own manuscript.

—Dr. Fridtjof Nansen, curator of the Bergens (Norway) Museum, goes this summer to Greenland, and expects to cross the country on sledges and snow-shoes.

—During the absence of Dr. Stuhlmann in Zanzibar, Dr. A. Schuberg occupies the position of assistant in the Zoological-zootomical Institute at Würzburg.

—Dr. P. P. C. Hoek, of Leiden, well known for his many morphological investigations, has been appointed to the scientific directorship of the Dutch Fisheries Commission.

—Dr. Ephraim George Squier, the well-known archæologist, died in Brooklyn, N. Y., April 17, 1888. He was born in Bethlehem, N. Y., in 1821, graduated at Princeton in 1848. His first work of note was the investigation, in company with Dr. E. H. Davis, of the mounds of the Mississippi Valley, the results of which formed the first volume of the Smithsonian "Contributions to Knowledge." Other works in the same line were his "Ancient Monuments of the West" and his "Aboriginal Monuments of New York." Later he was sent on government service to Central America, which resulted in several works on the ethnology and antiquities of that region. In 1863 he visited Peru, but his account of his investigations in that region was cut short in the middle of its publication by a mental disorder, which left him for the last seventeen years of his life utterly incapacitated for work.

—Henry James Storin Pryer, a well-known entomologist, died in Yokohama, February 17, 1888. Since 1871 he has resided in China and Japan, and at his death had in press an extensive work upon the butterflies of Japan, with English and Japanese text.

—The Pennsylvania Forestry Association appeals to Congress against the wide and wanton destruction of the forests. . . . Of the two bills now pending in Congress, No. 6045 provides a remedy for the mischief, and is greatly preferable to No. 7901. The for-

mer bill provides for the careful selection of proper lands for permannet forests, to be guarded from spoliation and destruction, and for the advantageous sale of merchantable timber under Government supervision, and with constant regard to the preservation of new growths. The bill also makes unauthorized cutting and injury a criminal offence, and establishes a system of guardianship and enforcement of the laws against individuals and corporations. The bill No. 7901 is much more loosely drawn as to protection from waste and injury, and lacks definite and strict methods of enforcing the law.

—Professor Joshua Lindahl, of Rock Island, has been appointed by the Governor of Illinois to the position of Curator of the State Museum at Springfield, in place of the late Professor A. H. Worthen.

—THE ZOOLOGICAL SOCIETY OF PHILADELPHIA is about to break ground for extensive additions to the reptile house. They are going to build two wings each thirty-two by twenty-eight feet, which will be simply conservatories. In one of these the tree-climbing snakes and lizards will be seen in the natural slate and among plants and shrubs as under natural conditions.

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## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON. — May 19, 1888. — The following communications were read: Mr. F. W. True, "The Hawaiian Bat;" Mr. Wm. T. Hornaday, "Man-Eating Crocodiles;" Dr. C. Hart Merriam, "A Revision of the Dipodidæ;" Mr. F. A. Lucas, "The Affinities of Chamæa."

June 2, 1888. — At the last meeting of the season the following papers were read: Mr. F. H. Knowlton, "Notes on the Fossil Wood of the Yellowstone Natural Park;" Mr. W. B. Alwood, "Notes on the Artificial Pollenation of Wheat;" Mr. F. A. Lucas, "Abnormalities in the Ribs of Birds."

PHILOSOPHICAL SOCIETY OF WASHINGTON, Saturday Evening May 26th, 1888.—The following communications were read: Mr. Robert T. Edes, "The Sphygmograph;" Mr. H. A. Hazen, "The Recent Mount Vernon (Ill.) Tornado;" Mr. Merwin-Marie Snell, "Observations on Certain Hypnotic Experiments of the Comte de Maricourt;" Professor E. D. Cope, "The Relation of Consciousness to Animal Motion."

Boston Society of Natural History. — May 16, 1888. — Professor Alpheus Hyatt read a paper on "The Evolution of the Faunas in the Lower Lias." Professor W. O. Crosby gave an account of the Geology of Nantasket.

Philadelphia Academy Natural Sciences.—November 15, 1887.—Prof. J. A. Ryder spoke of an improved method of preparing sections of animal tissue for microscopic examination. The object is first hardened as usual, then soaked in a solution of celloidin twenty-four hours, then in chloroform until the celloidin is transparent. It is afterward subjected to the action of paraffine before cutting. The use of celloidin enables the operator to make continuous thin sections of the most fragile structure without breaking.

Prof. Heilprin contravened Mr. Boulenger's criticism of his (Prof. Heilprin's) statement regarding the distribution of North American Lizards. He had defined a line drawn from San Francisco to Galveston as the southern boundary of the North American Lizard fauna, while Mr. Boulenger held that the North American fauna was a mere offshoot from that of the southern continent. The genera Sceloporus, Phrynosoma, Eumeces, and Ophisaurus, referred by Mr. Boulenger to the South American fauna were by Prof. Heilprin maintained to be North American with considerable distribution in the transition region.

Dr. Leidy called attention to a fragment of metamorphic limestone from Eldorado county, California, bearing on its surface a spot of native gold, and stated that it was the first example he had seen of gold occurring in limestone.

Descriptions of two new species of fishes from South America by Prof. D. S. Jordan, were presented for publication November 22d.

Dr. H. Allen called attention to the rugæ or ridges upon the palate. He proposed to name them the sutural, pre-sutural, and post-sutural folds. He had found certain peculiarities in man which served to distinguish the left side from the right.

The Rev. Dr. McCook described a spider from Florida. The web of this species was distinguished from that of other orb-weavers by having as many as fourteen cocoons, strung in the axis of the upper radius, and connected along one side by thick white threads. He named the species *Cyrtophora bifurca*. Dr. McCook also referred to a communication received Mr. C. Townsend, describing the nests of a white ant found in Honduras. Wood pulp seems to be the material used, and the nests are placed between branches of trees.

December 6, 1887.—Mr. Binder exhibited, among other fine minerals added to the Vaux collection, a specimen of Hiddenite, a mineral which from its rarity, is at present more valuable than the diamond.

Mr. Meehan called attention to the tubers of *Dioscorea eburnea*,

of China. The yield of tubers seemed to be very large, but they were intensely bitter.

December 13, 1887.—Dr. Leidy, in speaking of the presence of parasites in fish, mentioned the fact that the drum fish (*Pogonias chromis*) seemed in some cases to owe its flavor to a parasitic worm, *Acanthorhynchus reptans*. He also mentioned the occurrence of the larvæ of bot flies in terrapins.

December 20, 1887.—Prof. Heilprin discussed the rate of formation of deep sea deposits, and concluded that there were probably unknown factors that involved deposition in past ages at a greater rate than at present. Dr. Dolley remarked that in the Bahamas foraminiferal deposit was comparatively rapid; some of the smaller bays are being filled up by such material. He also spoke of what are called by the natives "banana holes," small pits with a deposit of soil and red earth, which may have been formed by the solution of the lime by the carbonic acid of vegetable matter.

January 10, 1888.—Dr. Leidy described the cranium of a puma recently found under about thirty feet of earth in the bed of the Kaskaskia river, Illinois. It differed from the cranium of recent animals in having a higher inter-parietal crest, a narrower outline, and a flatter forehead.

January 24, 1888.—Prof. W. P. Wilson stated that the appliances for capturing insects were much more efficient in *Sarracenia variolaris* than in the more common *S. purpurea*. He drew the conclusion that in *S. purpurea* the insect-feeding habit was disappearing.

Dr. Horn exhibited a collection of May beetles, including seventy-nine out of the eighty-one species known from North America north of Mexico, and containing three specimens of the very rare *Pleocoma*.

Prof. J. A. Ryder explained the law governing the cleavage of the yoke masses in the eggs of lampreys, frogs, and salamanders, and showed that, contrary to the dictum of Hertwig, it differed from that of the osseous fishes, birds and reptiles.

January 31, 1888.—Prof. Heilprin communicated the results of his studies of the geology of Nantucket, in 1886. The beds at Sankotty had yielded about fifty-five species of fossil mollusks. These beds had hitherto been described as post-pliocene, and the species identified with existing forms. The speaker had found a distinct species of Neptunea, besides minor differences in other forms. This proved that these beds are not so recent as has been supposed, and the disposition of the strata indicates a pre-glacial date.

Prof. W. J. Brooks gave the life-history of a jelly-fish, the mode of reproduction of which showed some peculiarities. All asexual forms hitherto known are only capable of reproducing forms like themselves, starting their offspring at the point at which they themselves started. This medusa, however, bears reproductive organs on tubes radiating from the stomach.

Prof. Wilson stated that the so-called sprouts or corky roots of

the black mangrove were largely composed of a peculiar tissue formed of large air cells, and that their function is the aeration of the plant.

Prof. Rothrock spoke of mimicry in plants, and gave as examples the alga-like outgrowth from the spores of mosses, the external resemblances of Zygadenus, and Swertia, and between *Nepeta glechoma*, and *Lamium amplexicaule*.

Dr. Dolley reported the occurrence of a large parasitic Ascaris in *Carcharias ceruleus* (the sand shark).

February 21, 1888.—Dr. Leidy described specimens of a small crustacean (*Cirolana*) found swarming in the bodies of edible crabs.

February 28, 1888.—Prof. H. C. Lewis exhibited a fragment of a meteorite containing diamonds.

Dr. Sharp described specimens of jelly-fish found in a fresh-water pond at Nantucket.

March 6, 1888.—Dr. Sharp spoke of the classification of lamellibranch molluscs and traced them from a central type such as Arca. He considered that the lamellibranchs had degenerated from the gastropods.

March 20, 1888.—Dr. Leidy called the attention of the Academy to numerous specimens of a minute parasitic crustacean from the gills of *Roccus lineatus*. They live suspended on the outer surface of the red gills of the bass. The species is the *Ergasilus labricis* of Kroyer, but is not mentioned in Rathbun's published list of parasitic Crustacea. The same fish frequently bears examples of the worm *Echinorhynchus proteus* in its intestines.

April 3, 1888.—Prof. Heilprin called attention to a human footprint in a slab of volcanic tufa from Lake Managua, Nicaragua. This footprint had been overlaid by a deposit of more than twenty feet in thickness, and the bones of the mastodon were said to have been found in the same deposits. The evidence to be drawn from the shells accompanying the footprint was not considered by the speaker as proving any very great antiquity.

April 17, 1888.—Mr. Meehan spoke of *Shortia galacifolia*, a rare North American plant, of which several thousand examples have been found in the mountains of North Carolina.

Dr. Koenig described a specimen of eleonorite from Sevier county, Arkansas. It occurs in cavities of dufrenite, and is of a blood-red color. The only specimens of the mineral heretofore known have been from the Eleonore mine, near Giessen, Germany.